SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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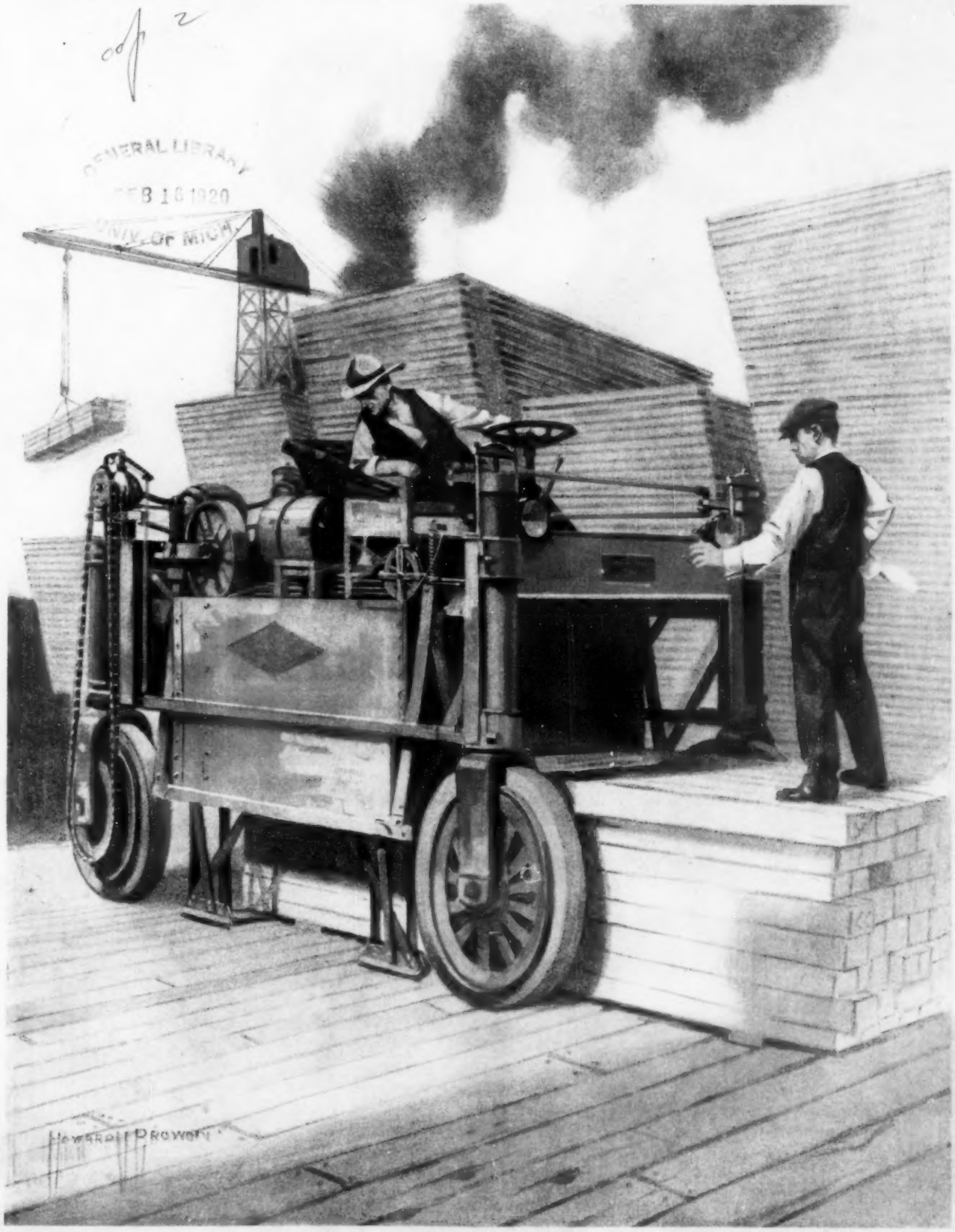

SPEEDING UP THE HANDLING OF LUMBER WITH THE STRADDLE TRUCK

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"BARNES-MADE" PRODUCTS
1857
SCREW MACHINE PRODUCTS

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Since 1857 the term *"Barnes-Made"* has been symbolic of a continuous and expanding service in designing and constructing high-grade springs.

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Steam—Buried Alive

UNDERGROUND steam distribution —steam buried alive and kept alive by proper insulation — is a task that is never easy.

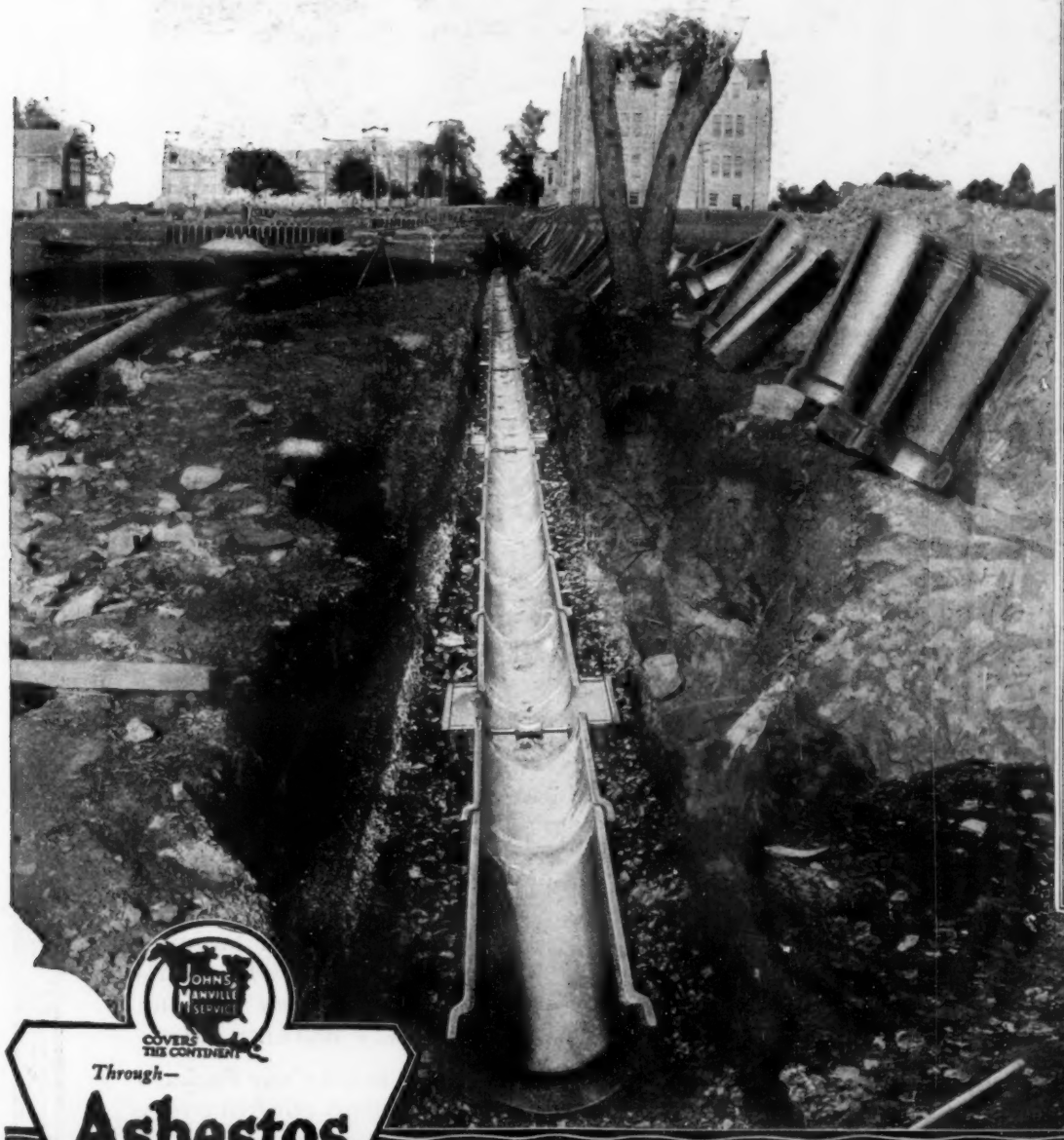
For underground insulation must permanently retain its heat-saving efficiency, even though buried in trenches, surrounded by cold earth and exposed to moisture and the bacteria of decay.

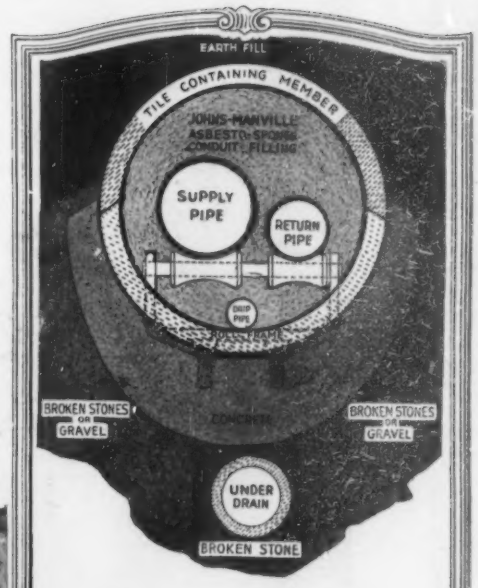
Through careful study of the conditions encountered, combined with exhaustive laboratory research and practical experience, Johns-Manville has been enabled to solve this problem successfully.

As a result, the efficiency of the Johns-Manville Underground System of Insulation is known in advance and is guaranteed to be 90% or over.

But underground steam distribution is only one phase of this company's vastly important basic business—the scientific insulation of indoor piping.

And today, the more unusual or difficult the insulation problem, the more likely you will find that Johns-Manville has been set to solve it.





How steam is kept alive underground

THIS cross-section of a typical Johns-Manville Underground System of Insulation shows how carefully every contingency is provided for.

The Asbesto-Sponge Filling, which completely surrounds the piping, is the material which acts as such an efficient and durable insulation.

The other details of the system consist of the tile top and bottom containers to hold the Asbesto-Sponge around the piping; the frames and rolls to provide supports for the piping and allow for expansion and contraction; the concrete bases for the roll frames; and the loose jointed drain underneath to take off any water that might approach the system.

Some idea of the efficiency of the Johns-Manville Underground System of Insulation may be gained from the fact that it is guaranteed to save at least 90% of the heat that would be lost from exposed pipes.

H. W. JOHNS-MANVILLE CO.
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For Canada
Canadian Johns-Manville Co., Ltd., Toronto

JOHNS-MANVILLE SERVICE COVERS THIS CONTINENT

Through—

Asbestos

and its allied products

JOHNS-MANVILLE
Serves in Conservation

Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

JOHNS-MANVILLE
Serves in Conservation

On the Lincoln Highway—truck thrown into the ditch by the breaking of a defective steering knuckle. Statistics show that 88.4 per cent. of all truck accidents are due to internal weaknesses.

How Much is American Business Taxed by Avoidable Breakdowns

E. H. HARRIMAN used to say that no man achieves anything worth while unless he takes all the responsibility and holds absolute control.

The Packard Company has always taken full responsibility for its trucks because it controls their building from the ground up.

Every part designed by Packard—controlled by Packard through foundry, forge, machining and finishing—a Packard engineering unit, tested by Packard every step of the way.

PACKARD owns and operates the most extensive heat-treating and finishing plant in the world—producing a steel that is stronger than the average by 35,000 to 62,000 pounds to the square inch.

The steel in the rear end of a Packard truck costs 22c a pound—as against 9c for the steel ordinarily used.

Each run of steel is tested to the final limit of strength. Each finished part to highest known standard of accuracy.

Packard engines are run on the block to an equivalent of 1000 miles road service. A Packard truck is ready to do a full day's work *when it is delivered.*

THE business man runs his trucks for what they will *do.*

Transportation is his object—not having defective parts "made good" free of charge.

The Packard business is not a business of assembling parts made here and there. It is not a trade in repair parts.

It is a business of building trucks for the man who wants *transportation* every working hour of every working day.

And this is why the Packard Company keeps control every step of the way—clear back to the timber in the forest and the ore in the mine.

"Ask the Man Who Owns One"

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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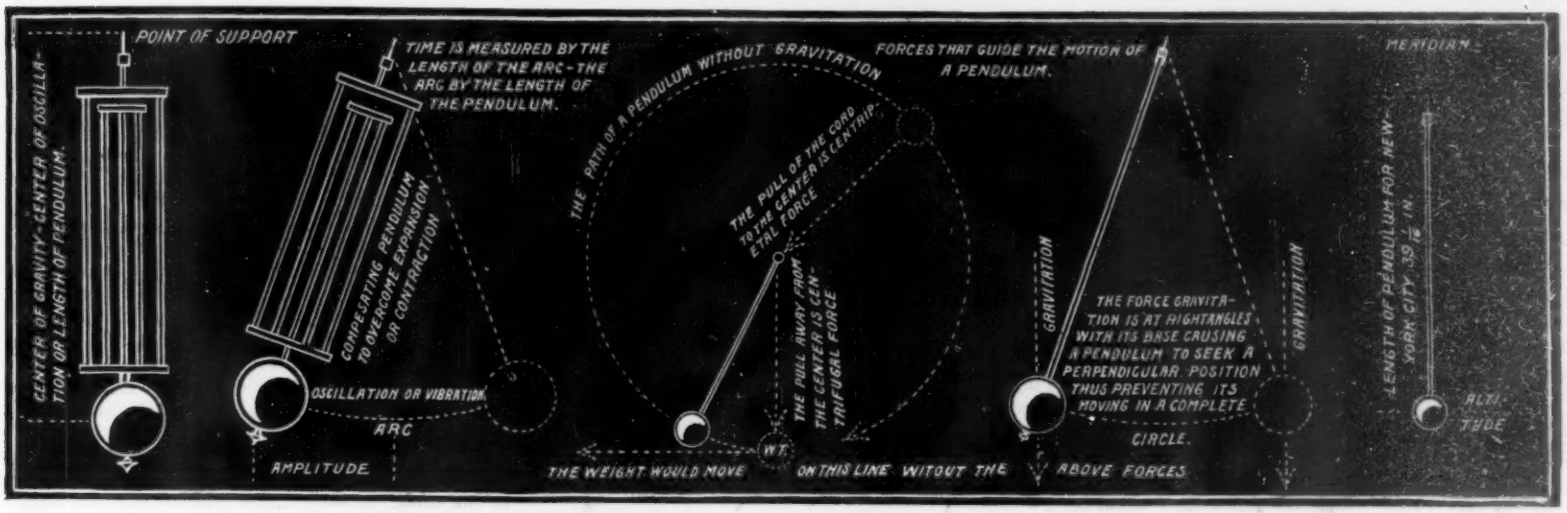
POINT OF SUPPORT
CENTER OF GRAVITY-CENTER OF OSCILLATION OR LENGTH OF PENDULUM.
TIME IS MEASURED BY THE LENGTH OF THE ARC-THE ARC BY THE LENGTH OF THE PENDULUM.
COMPENSATING PENDULUM TO OVERCOME EXPANSION OR CONTRACTION
OSCILLATION OR VIBRATION
ARC
AMPLITUDE
THE PATH OF A PENDULUM WITHOUT GRAVITATION
THE PULL OF THE CORD TO THE CENTER IS CENTRIPETAL FORCE
THE PULL AWAY FROM THE CENTER IS CENTRIFUGAL FORCE
W.T.
THE WEIGHT WOULD MOVE ON THIS LINE WITOUT THE
FORCES THAT GUIDE THE MOTION OF A PENDULUM.
GRAVITATION
THE FORCE GRAVITATION IS AT RIGHTANGLES WITH ITS BASE CAUSING A PENDULUM TO SEEK A PERPENDICULAR POSITION THUS PREVENTING ITS MOVING IN A COMPLETE
CIRCLE.
ABOVE FORCES
GRAVITATION
MERIDIAN
LENGTH OF PENDULUM FOR NEW YORK CITY 39 1/8 IN.
ALTITUDE

The forces that guide a pendulum, and what its motion would be without these forces

Why Does Your Clock Keep Time?

DOES your watch or your clock keep time because each has a spring which you have discovered must be wound at a given time or in a particular manner to make either instrument go at all? or is it because of a regulator that suggests to you in an oblique way that at certain times you may do certain things either to the fast or to the slow side of its mechanism to obtain possibly more satisfying results? or is it because of the pendulum in the clock or the "balance wheel" in your watch, or the small hand that goes tick, tick, on an endless exploring expedition round and round the dial? Certainly there is no sane, reasoning individual who has had his common percentage of experience with time-pieces, good, bad and indifferent, who is willing to swear that there is any visible thing—movable or otherwise—about a clock or a watch that is directly responsible for either of them keeping time.

Every part that we have named, and every part that has been left unnamed, has time and again been observed apparently in its proper place and performing its supposed function, yet the instrument would not keep accurate time. There are innumerable cases where these refractory instruments have been subjected to the ministrations of experts, only to be returned to their owners in a condition less worthy of confidence or respect than when they went forth to be "doctored" or "repaired." We are told that a time-piece is a very delicate mechanism, and most of us are prepared to admit that a time-piece is a *very* delicate piece of work.

Yet in spite of the difficulty and expense involved in trying to keep on time, few of us realize just how delicate a time-piece is, or know the principle of its construction, or what it is really supposed to do. The multiplication of seconds, minutes, hours, days, months and years is not a process that a man-made instrument can arbitrarily direct. The laws of the universe must be obeyed in the matter of time as in other affairs. If man, to illustrate, should construct a chain of watches set edge to edge clear around the world, it would be found that each watch would have to be regulated to a different time to represent approximately the correct time for the space of the earth's surface that each watch would cover. We say "approximately," for to be absolutely correct—a thing, of course, that is impossible—we should have to divide the dial space into needle points, each point representing a meridian point for calculating the sun's movement.

It is the calculation of meridian points that makes the time in Paris, London, New York, Chicago, San Francisco, and so on around the earth, differ so much in hours. The sun divides time into days, months, years, and so on, but man has sought to divide the days into hours, minutes and seconds, an undertaking that has proven so difficult that his efforts have never been crowned with success, for the reason that the days, the months, and even the years, are of varying length. Astronomical clocks occupy a given meridian and are regulated daily by the sun on that meridian; approximately, they regulate time over local areas and extended latitudes, but by astronomical calculation and the use of electrically operated mechanical devices, a single clock can be made automatically to regulate clocks in any meridian, just as New York clocks are regulated at twelve each day from Washington.

When a time-piece gets out of order, we take it to an expert, and the first thing that he does is to set it going, then listen with attention to its escapement or tick; and well he may, for in spite of its case of precious metal and jewels set in its mechanism, it is useless as a keeper of time unless the tick is right. Every wheel, screw, lever, spring or other part is there for no other purpose than to try to make the tick uniform and correct. It is the tick that makes your watch keep time, and the swing of the balance-wheel demonstrates the existence of two laws, gravitation and centrifugal force, without which your clock could not go at all.

The tick is a noise-producing operation of the pallets, as the clutch releases the teeth of the escapement wheel; but it is, nevertheless, caused by the natural oscillating movement of all suspended bodies. Junis, of the University of Cordova, knew of this movement and invented in 1100 the first instrument to demonstrate it. This apparatus is known as a pendulum and its movement as *vibration* or *oscillation*. Gerbert, a companion of Junis, invented the first escapement for keeping a pendulum in motion, and it was used in this form to demonstrate the common vibrating movement of all free suspended bodies. It was not until the boy Galileo observed, in the cathedral at Pisa, that the height of the vaulted roof could be measured by the time of the vibrations of the chandeliers suspended at different altitudes, that it was suspected that the pendulum had any particular measuring quality. It was in 1581 that Galileo recommended the pendulum as a true measurer. It had been applied to clocks, however, as early as 1364, with no understanding of its true quality, it would seem; but in 1612 it was used in combination with wheel work with recognized appreciation of that value.

As a measurer of time the pendulum ranks today as the most perfect of our instruments; it is the part of a clock that keeps time. All the rest of the mechanism is simply for the purpose of keeping up its vibration or to point on a dial the number of vibrations it has made. It swings back and forth in a complete arc thirty times each minute, but allows the escape-wheel to move a cog at each double vibration, thus checking off on the dial, by means of the second hand, sixty seconds of time. In a similar way, minutes and hours are recorded, and by a like process a watch is guided.

February Issue of the Scientific American Monthly

WHAT shall we do when our coal and oil supplies are exhausted? It is true that we may obtain power from water, from the wind and from ocean waves and tides. The first two mentioned sources will not begin to supply us with all the power that we need. Tides yield but small returns on large investments for extensive plants, and the difficulties of harnessing the ocean are almost insuperable. Where then, shall we turn for future sources of power? In a very interesting lecture delivered by Sir Oliver Lodge, this question was taken up, and he pointed to the vast sources of atomic energy which as yet have not been touched. It may be that we shall some day find a method of utilizing these sources of energy. Sir Oliver's paper is reproduced in full in the February issue of the SCIENTIFIC AMERICAN MONTHLY, and will prove very interesting reading.

The public was startled recently by newspaper announcements that a rocket had been invented which would carry as far as the moon. Sensational as this statement appeared to be, it was, nevertheless, issued by the Smithsonian Institution, and was based on the work of Dr. Robert H. Goddard, of Clark University, who has been conducting a long series of experiments on existing forms of rockets. He has developed a method of increasing the efficiency of this type of projectile to such an extent that it will be possible to

(Continued on page 142)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Thousand-foot Liners Abandoned

THE abandonment by the Shipping Board of the ambitious scheme of its former Chairman, E. H. Hurley, to build and operate two 30-knots steamships, each one thousand feet in length, is to be commended, first for the reason that there is no call for ships of that size and speed, and secondly because their first cost and the cost of operation would be so great as to condemn them to failure. It will be remembered that the scheme as originally put forth contemplated the creation of a terminal at Montauk and the double-tracking of the Long Island Railroad, with the idea of conveying passengers and mails more expeditiously to New York. The Montauk plan found no favor—if only for the reason that passengers would be unwilling to go to the trouble of a transfer from ship to train, when they could go right through to New York in comfort at the cost of only an hour or two longer on the water.

But the construction of these huge ships at a cost each of not less than $25,000,000, would have been an act of folly at the present time. The Shipping Board has problems enough on its hands just now, without saddling itself with two such white elephants as these ships would prove to be. The element that would be fatal to success would be the high speed of 30 knots, which would invoive an enormous first cost in boilers, turbines and auxiliaries, and the huge fuel bill representing, if in coal, not less than 17,000 tons per day. Twenty years ago, when the "Deutschland" first passed the 23-knot mark, she was found not to pay. The "Mauritania" raised the speed to 26 knots, but she burned 1,000 tons of coal a day in doing it.

Far more profitable vessels are the 535-foot, 17-knot combined passenger and cargo ships of which the Shipping Board is now building nineteen. Ships of this type afford every luxury of travel and they are sure revenue earners.

The Problem of Our Railroads

MORE than any other agent, transportation has been responsible for the phenomenal growth of the United States in population, agriculture, industry and wealth; and to speak of transportation is to speak of our great railroad system with its 260,000 miles of track. If it be true that the railroads have made the country, it is equally true that our prosperity is absolutely dependent upon the continuous healthy functioning and growth of our railroad system. The enormous stress to which the country has been subjected during the war and during the period of reconstruction was nowhere felt so severely as by our railroads, and because they are of such vital importance to the wellbeing of the country, they should receive the very first and the most careful consideration.

As matters now stand, the credit of our railroads is seriously affected; both the property and the equipment are so greatly depreciated that they will take years to recover; the organization has been broken up and discipline gravely affected; and in regard to labor, a burden imposed by Government decree has been laid upon our railroads which makes the question of their profitable operation appallingly difficult. The one ray of light in the situation is the fact that the experiment of Government operation has so discouraged the public, that any fear of a public call for Government ownership has been indefinitely removed.

A most informing analysis of the whole situation was recently made in the *Engineering News-Record*, and the figures there given tell a story so easily understood that he who runs may read. First, as to the physical conditions, we learn that under normal operation, our railroads required about 2,000,000 tons of steel rails per year, whereas in two years, the Railroad Administration has purchased directly only 200,000 tons of steel rails. Annually, the railways require about 100,000,000 new ties, but apparently, under Federal control there will be a shortage of about 25 per cent, or say 50,000,000 ties. During the four years prior to Federal control, the railways built an average of 100,000 freight cars per year, whereas the Administration has purchased only 100,000 freight cars in two years, of which only 90 per cent have been delivered. Moreover, during the past two years, freight equipment has not been maintained in normal condition. It is estimated that about 200,000 new cars must be built in 1920 to make good the deficiency.

The same story of shortage has to be told with regard to locomotives. The normal requirements are about 3,000 new locomotives per year. Yet during Federal control, only 2,000 locomotives, or one-third of the normal requirement, have been provided. Finally, with regard to passenger cars, there is an increase of only 923 cars in two and one-half years, and there has been a large depreciation in the condition of this rolling stock. It is estimated by our contemporary that the requirement for the new passenger equipment will be at least twice the normal for the year 1920.

The showing is no better in the matter of improvements and new lines, for during the two years of Federal control, only about one-half the normal expenditures will have been made on improvements. Indeed, less mileage, we are told, was added in 1918 than in any year in the past thirty years, only 721 miles having been built. It is estimated that, to meet the transportation needs of this country, from 1,000,000,000 to 1,500,000,000 dollars will be required annually for the next five years.

Everyone is more or less familiar with the main facts of the labor situation. We all believe that labor should have a fair deal. We also believe that the public, including the owners of railways, should have a fair deal. Now, in May, 1918, an order was issued and numerous supplements, addenda and interpretations have subsequently appeared, as a result of which the annual cost of railway labor has advanced to approximately $1,200,000,000 over that of 1917, and in view of the present relative inefficiency of labor, which is universally recognized and admitted, it is considered that the annual labor cost has practically increased to $1,500,000,000 over that of 1917. Compare these figures with the fact that the combined returns to capital of $18,000,000,000 invested in our railways is now only about one-half the annual increases granted to railway labor under Federal control.

It is true that there were increases in freight and passenger rates which totalled about $900,000,000 per annum, but the cost of railway labor alone, bearing in mind its decreased efficiency, will be one and one-half times the increase in rates. Hence, it is claimed that a further increase of at least 25 per cent in freight rates is necessary to make up the deficit in operation and to give a fair return on the capital invested. It is believed that if this were done, the railroads would be in a position to take care of themselves and put tracks and general plant in first-class condition. By making such an increase the entire railroad problem would be solved. Let us repeat again that the interests of the nation and the interests of the railroads are inseparable.

Can We Make Up Europe's Coal Shortage?

UNTIL the close of the last century, Great Britain was the largest coal-producing country in the world; but at that time our production overtook hers and we have since maintained and increased our supremacy. Nevertheless, until 1914, Great Britain was the largest exporter of coal, sending abroad in the year 1913 over 77,000,000 tons. The British Inspector of Mines recently stated that a reduction of one hour would decrease the British output some ten per cent, and it is estimated that the output for 1920 will show a reduction of 70,000,000 tons from that of 1913. He further stated that if the restrictions on the consumption of coal were removed, the increase in internal consumption would leave for export only about 7,000,000 tons.

France has not only lost the output of mines in the regions overrun by Germany, but she has lost thousands of her best miners. The coal regions of the Saar district and the recovery of Alsace and Lorraine do not better the situation, this for the reason that so large a proportion of the new coal available is absorbed in the local industries of the recovered provinces. Hence, it is estimated that France faces a deficit of 20,000,000 tons.

The Germans did not destroy the Belgium mines, reserving them for themselves. The coal deficiency in Belgium, therefore, is estimated at about 13,000,000 tons. In the opinion of the fuel expert of W. R. Grace & Co., the European country that will suffer most keenly from Great Britain's reduced export of coal is Italy, which in 1913 imported from Great Britain 10,000,000 tons of coke, coal and briquettes.

Germany, which ranked next to Great Britain as an exporter of coal, has lost a considerable portion of her coal area and is expected to show a decline of 50,000,000 tons per year. She exported before 1914 about 35,000,000 tons; hence in the opinion of this authority it can be seen that she will be able to do little, if any, exporting for some time to come.

Therefore, it can be understood that Europe in her serious plight, is looking to America to make up her shortage of fuel. We are told that the total area of the tried fields of coal of the United States is estimated at about 310,000 square miles, but we, like the rest of the world, have our labor troubles, and our output this year is expected to show a falling off of between 90,000 and 100,000 tons. It is the expectation that in the near future, we shall speed up production by intensified mechanical methods. Already the tide of immigration is beginning to set our way, and it will doubtless bring many recruits into the mining centers. Our Shipping Board estimates that we must send abroad 81,000,000 tons, whereas the nation's pre-war export of coal was less than 20,000,000. If the world's shortage is to be made up, then we must send abroad an excess over pre-war exports of over 61,000,000 tons.

The trouble, therefore, comes back to the question of shipping. Mr. H. Y. Saint, head of the Export Coal Department of the Division of Operations of the Shipping Board, in a recent report drew attention to the fact that the total coal requirements of the world during this winter would be about 180,000,000 tons, of which 98,000,000 tons can be supplied by countries other than the United States. He also estimated that we could furnish nearly 20,000,000 tons, leaving a shortage in the world's coal bin of about 62,000,000 tons. Attention is drawn to the fact, moreover, that it will be impossible for us to find shipping to carry this coal, and that the nations of Europe must withdraw some of their shipping from other trades, and place it in the American coal trade, even if they should find it less profitable to do so. To show what the shortage means, he tells us that it would take 25,000 trains of 50 cars each, merely to haul this coal to the seaboard.

Pyrometry

THIS subject is of such obvious importance that it seems worth while to call attention to a volume which has been published by the American Institute of Mining and Metallurgical Engineers which is a republication of the papers presented at the Chicago meeting of the Institute last September when a symposium on pyrometry was held in coöperation with the National Research Council and the National Bureau of Standards. This collection of papers is believed to be the best ever obtained on the subject and the list of topics and authors is ample to guarantee the interest of any one working at high temperatures. The subject matter is divided under three headings: 1st, Methods of Pyrometry; 2nd, Industrial Pyrometry; and 3rd, Pyrometry and Its Relation to Science.

Automobile

Unsuitable Trucks not Economical.—It will more than pay every concern employing motor trucks to make doubly sure that its motor truck equipment fits local transportation problems and is fully equal to meet all transportation demands. When a concern has the right sized and proper kind of motor trucks, the owner is securing the very lowest cost per ton-mile for delivering or hauling goods or materials. But when he has the wrong kind of motor truck equipment his cost of transporting goods or material is greater and the difference between this overcost and what he would pay if his equipment fitted his demands, represents an unnecessary loss.

Inspect Wheels Frequently.—On all cars having the rear wheels secured to tapered shafts, and most of the popular cars use this construction, care should be taken that the hubs are kept seated tightly on the taper end of the axle by means of the clamping nuts. The rear hub caps should be taken off and the lock nuts screwed up as much as possible without injuring the threads. If this is not done the hub may work loose on the shaft and by knocking against the key will certainly spread the key-way in a comparatively short time. The car should be jacked up when the wheels are tested because a wheel may apparently be tight if the car weight rests on it and yet be loose when relieved of its load. Wire wheels are usually installed over master hubs and locked in position by lock nuts. It is good practice to inspect these lock nuts frequently and tighten same. If a wheel becomes loose on the inner hub it will creak and in time injure the fitting by wearing the hub out of round.

Horses and Automobiles.—Since 1899 the United States has produced over 7,700,000 automobiles according to Government statistics. Over half of this number were manufactured since the end of 1915. It has been stated that manufacturers propose to put out over 2,000,000 cars valued at $1,500,000,000 in 1920. Some motoring enthusiasts think the horse is doomed to the fate of the mastodon or at the best, a cage in the Bronx Zoo. On the contrary horses are on the increase. There are 21,534,000 in the country now, and of their poor relations, the mules, there are 4,925,000, and the total value is $2,800,000. Horses or mules were never more numerous or valuable. In Europe the American horse is very popular for they have been exported by thousands, and in 11 months of the fiscal year added $5,000,000 to our export trade. The reason that automobiles do not supersede horses is that the growth of the country has been so great that all existing methods of transportation either animal or mechanical are not adequate for the requirements. Horses have a place on the small farm that mechanical appliances developed to date cannot fill until the small farmer becomes familiar with and appreciates the value of mechanical power.

Automobiles in New York State.—Figures published by the Secretary of State show that on August 1st the registration of motor vehicles in New York was 4,771 cars over a half million. During the last six months over 68,000 motor vehicles have been added, the number of chauffeurs has grown by over 21,000; motor trucks have increased by over 13,000 but motorcycles are used in decreasing numbers as there are now 4,789 less of the two wheelers. This is a surprising fact. The part which the last six months have played in the automobile records of the State, as compared with all of last year, can be seen in the fact that as compared to a twelve months' registration of 1918, the first six months this year show an increase of 32,686 in pleasure cars; 951 in omnibuses; 7,767 in commercial cars; a decrease of 585 in trailers and an increase of 194 in dealers. These figures, it should be borne in mind, are for six months of this year as compared with twelve months last year. Reports from many other States indicate that motor car use is advancing rapidly. Statistics for last July in Massachusetts showed that more than 200,000 automobiles were registered in that State on July 1, 1919, exceeding all former six months' records. On July 1, 1918, the total was 179,000. In fact, the only apparent limit at present seems to be the ability of the factories to produce cars. The purchasing demand is still greater than the production possibilities.

Science

Sir Richard Glazebrook, C.B., F.R.S., has retired from the directorship of the British National Physical Laboratory, and has been succeeded by Prof. J. E. Petavel, F.R.S., late of the University of Manchester.

A Key to American Gall Insects.—What is said to be the only reasonably complete publication on the plant galls found in America and the insects that cause them has been published recently by the New York State Museum, as its Bulletin 200. The work provides a key to 1,439 species and contains 250 text illustrations and 16 full page plates.

The British Rainfall Organization, after having been maintained for sixty years as an unofficial enterprise, has just been taken over by the British Government and placed under the control of the Meteorological Office. The annual publication known as *British Rainfall* will be continued, as will the monthly journal of the organization, *Symon's Meteorological Magazine.* Dr. Hugh Robert Mill, who has been director of the organization for 19 years, is retiring on account of impaired eyesight.

Nieve Penitente.—An interesting memoir on the *penitentes,* or pinnacled snows, of the Argentine Andes has recently been published by the Geological Section of the Argentine Ministry of Agriculture. The author, Juan Keidel, reaches the conclusion that *nieve penitente* is caused neither by wind nor by ice movement, but wholly by solar radiation falling on the ice surface from different angles with the daily and seasonal changes in the position of the sun. His paper is illustrated, and accompanied by a bibliography.

Incompatibility of Quinine and Aspirin.—According to a note now going the rounds of the medical journals, a Spanish physician, Dr. Saenz de Santa Maria y Marron, has found as a result of a year's experience that the combination of quinine and aspirin is an undesirable one. It appears that under the catalytic action of aspirin in the stomach the quinine is changed to a toxic derivative, which has been termed quinotoxin. The latter has the reputation of being able to cause death, though fatal cases were not noted by the Spanish investigator.

Undergraduate Research in Medical Schools.—Detailed information concerning the extent of undergraduate research in American medical schools and the attitude of the school authorities toward such research has been gathered by the William Pepper Medical Society, composed of undergraduates at the University of Pennsylvania. Formerly research on the part of undergraduates was discouraged or forbidden at a large number of medical schools, but in the past few years most of these schools have abandoned their opposition. Several schools now permit the substitution of time spent in research for a certain amount of the regular course.

The Twelve-mile Shaft Project Revived.—At the meeting of the British Association in 1904, Mr. (now Sir) Charles Parsons discussed at some length the feasibility of sinking a shaft to a depth of twelve miles in the earth; about ten times the depth of any shaft in existence. He concluded that the work could be accomplished in 85 years at a cost of $25,000,000. This suggestion aroused much interest throughout the world, and has often been referred to down to the present day. Subsequently, at the suggestion of Parsons, Prof. Frank D. Adams, of McGill University, made exhaustive experiments to determine whether rock-pressure at so great a depth would crush the shaft in and destroy it. In an article published in the *Journal of Geology* in 1912 he presented facts indicating that the construction of even deeper shafts was practicable; viz., 15 miles in limestone and 30 miles in granite. In his presidential address before the 1919 meeting of the British Association, Sir Charles has discussed this interesting subject further, pointing out the paucity of existing knowledge concerning the interior of the earth and the valuable information that might be secured through sinking the proposed shaft. The cost of a shaft 12 miles deep, at present-day prices, would not be much more than the cost of one day of the recent war to Great Britain alone.

Electricity

A Canadian Long-Distance Transmission Line is being erected from Winnipeg to Portage la Prairie. This line will be 60 miles long, will use steel towers and will have an ultimate capacity of 20,000 kilowatts. The immediate installation is of one circuit of No. 0 aluminum cable which is estimated to carry 5,000 kilowatts at 66,000 volts with a 3 per cent drop in voltage at Portage la Prairie, or 10,000 kilowatts with 15 per cent voltage loss. The second circuit will be installed as soon as the demand for power warrants it.

For Removing Stencil Marks from shipping boxes and barrels, for surfacing floor treads, desk and table tops, and for other uses there has recently been introduced an electrically-driven hand sander. A 1/3 horsepower electric motor, on a light running truck, drives through a flexible shaft a sanding head 5½ inches in diameter, made of metal and covered with felt, around which is placed a piece of sand paper 3 inches wide. A slot is provided across the sanding head through which the ends of the sand paper are drawn and held in place by a quick-acting clamp.

Combination Electric Dishwasher and Sink.—A vertical cylindrical electric dishwasher has been incorporated as a part of a kitchen sink and placed on the market by a Chicago company. The combination is made up of very few parts and is constructed of cast iron covered with porcelain enamel. Two perpendicular revolving paddles throw the water between the dishes, which remain stationary, toward the center of the dishwasher. The motor can be used for making ice cream by replacing the dish frame with a special freezing can. The domestic sized outfit is operated by a ¼-horse-power motor with an attachment cord that fits any lamp socket. This combination is also made with a capacity of 6,000 ordinary dishes per hour for use in restaurants, hotels and hospitals.

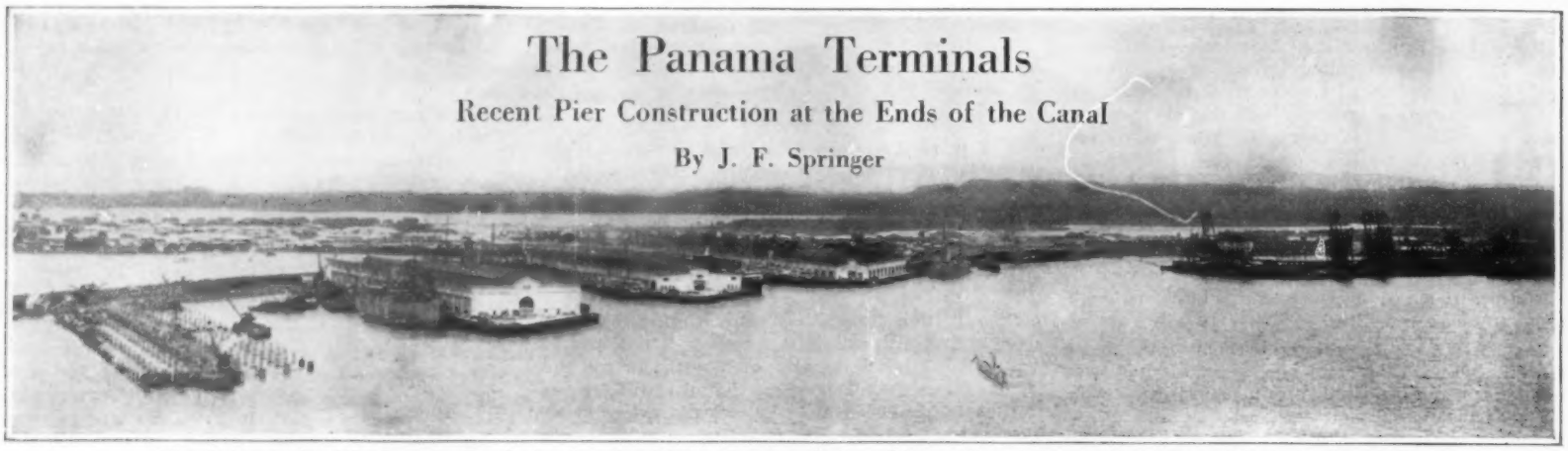
Detection by Heat Radiation.—A recent issue of the *Physical Review* contains a summary of a paper read by S. O. Hofman at the Washington meeting of the American Physical Society on the above subject. In trench warfare on the Western front operations took place mainly in the night time, as any movement during the day quickly attracted hostile fire. An attempt was therefore made to detect men moving in No Man's Land by recording the heat radiated from their bodies. The receiver for this purpose was a thermopile at the focus of a 14-inch parabolic mirror, and connected to a D'Arsonval galvanometer. It was found that with his sensitive apparatus the presence of a man could be detected at a distance of 600 feet, and the device appears to have proved very useful for detecting hostile raiding parties creeping towards the trenches by night. It is also suggested that the method might be made the basis of a short-range form of secret signaling.

Detecting Sounds Under Water.—It is known that sound can travel readily through the sea and be detected at distances of many miles. This fact has been taken advantage of in the methods of submarine signaling which had already proved of use before the war. One of the most striking developments for the detection of submarines during the war has consisted of a method of sound ranging under water, by which it is possible to fix with great accuracy the positions of points hundreds of miles from shore, according to W. H. Bragg, writing in the *Times Engineering Supplement.* It has been shown that the shock of an explosion under water creates a sound pulse with a very sharply defined front which can travel unchanged in character under water for great distances. A number of submerged hydrophones are laid a few miles apart from each other at suitable distances from the shore and are connected up to a recording galvanometer in a central station. Six hydrophones are generally employed, and the records of the six are photographed on a moving strip of motion-picture film. As long as nothing happens the records of the six come out as six unbroken lines. If a noise strikes one of the hydrophones, the spot of light is instantaneously deflected and the continuity of the line is broken. By measuring the intervals between the times of arrival of the sounds on the various hydrophones, it is possible to locate the origin of the noise.

The Panama Terminals

Recent Pier Construction at the Ends of the Canal

By J. F. Springer



Atlantic terminals of the Panama Canal, showing piers Nos. 6, 7, 8, 9 and 10, and the coaling station, as they appeared in September, 1917

THE recently completed Pier 6 at Cristobal is one of the final features of the great Panama Canal as planned by the Americans. At the Atlantic terminus, the canal runs from north to south through Limon Bay, with Cristobal on the left. Jutting out from the shore on the city side is a great mole which is still in an unfinished condition. When complete, it will reach almost to the left bank of the submerged canal. On the south side of this extension from the land are a number of parallel piers, all extending to the southwest. Pier 6 is the one which lies nearest the canal and not far from the present terminus of the extension. Naturally, the waters within are comparatively quiet.

Cristobal Mole is really a great fender stretching a good way across Limon Bay from the east and sheltering the waters within. While the mole is not itself complete, the preliminary borings were finished some three years ago. The greater part of this exploratory work for the extension of the mole was done with the well-known wash drill, but some boring was also done with the diamond drill. The mode of construction adopted in extending the mole was to build wooden trestlework and then run trains out on it and dump overboard their loads of rock. Soft rock was largely used for the main body of the work, but hard rock was placed on the north side where there is direct exposure to the action of the Caribbean Sea. Railway tracks extending out from the shore provide a very considerable amount of storage space right on the mole itself. Branches from these tracks run out on to the several piers. At the inner end of the mole and on the south side is a triangular projection from the shore which forms, in effect, an integral part of the scheme. The waterfront sides of the triangle are Docks 9 and 10.

For a ship entering *via* the canal from the Atlantic Ocean, the heads of the piers are reached simply by a 90-degree swing to the port side. Here the plans call for a 41-foot depth of water. This depth is not maintained, however, along the whole waterfront of the harbor. The depth of the Old French Canal averages no more than 30 or thereabouts. Even now the total frontage for vessels in the inner harbor is considerable; and when the mole is pushed all the way out and Piers 4 and 5 added, it will be still greater. Altogether, the port facilities at Cristobal will be very modern and of considerable extent.

The construction of the Panama Canal has entailed a good deal of subordinate work. The harbor facilities provided at Cristobal constitute a notable example of this. The shop, coal plant and wharf construction at Balboa, the Pacific terminal, are another striking instance. In respect to the operation of the two terminals, there is a sharp advantage on the side of Cristobal. The tidal difference at the northern terminus is only a foot or two, while at the southern terminus it amounts to a score of feet or more, and greatly complicates loading and unloading. This consideration doubtless had weight in the decision to locate the chief coaling plant at Cristobal. However, the fact that coal could be transported from coal ports on the Atlantic seaboard to this point without needing to pass through any part of the elevated portion of the canal was perhaps the decisive factor.

It is perhaps too early yet to say just what part the two terminal ports will eventually play in connection with the canal. They are connected with each other by the canal itself and also by the Panama Railroad. The question naturally arises whether these ports will have anything more than local significance. The great shops at Balboa and the great coaling plant at Cristobal will doubtless greatly facilitate the operation of steamships passing through the canal to distant destinations. They provide for big and little repairs and supply the necessary fuel. So far, the matter is fairly clear. Will things develop further? Will products in any considerable amount be brought from the interior to either port for water shipment thence to the world at large? Will either become a point to which imports in quantity for the hinterland will come? These are questions that can hardly be answered now. And yet, the plans of the engineers must have some reference to such matters.

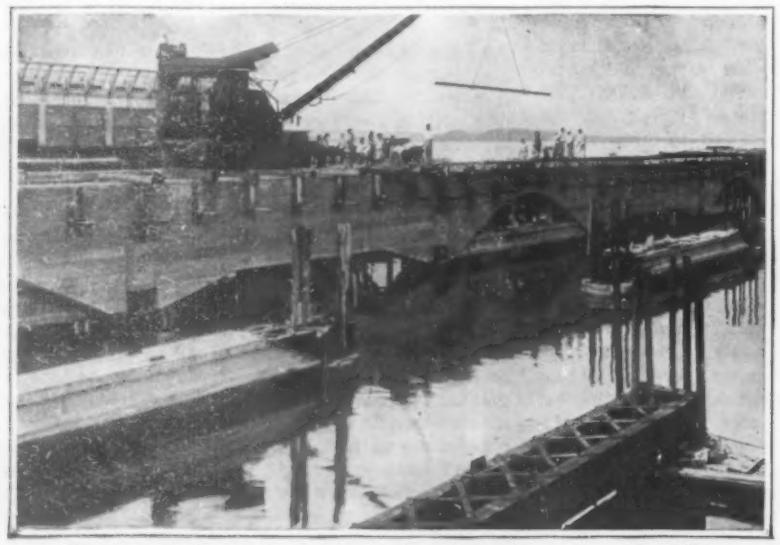
THE Panama Canal is, in its simplest terms, a waterway, consisting of two artificial lakes with locks and dredged channels. But the Canal, as an operating proposition, is vastly more than a waterway; it comprises a notable equipment in the way of terminals, without which it would remain a waterway and nothing more. In this discussion, Mr. Springer tells us the essential facts about the terminal facilities which have been built in connection with the Canal.—THE EDITOR.

While the engineers cannot determine just what Cristobal and Balboa are ultimately to become, they have to see into the near future, and provide construction that will be utilizable for further development if that should be demanded. When all construction work on canal accessories has come to an end, it may seem clear that the normal operation of the canal will not require all the piers and docks at present in contemplation. Thus Pier 4 may not be needed. If so, it may be omitted. The mole, however, will probably be necessary all the way to the farthest end contemplated, because of the requirements of shipping for adequate protection against storms.

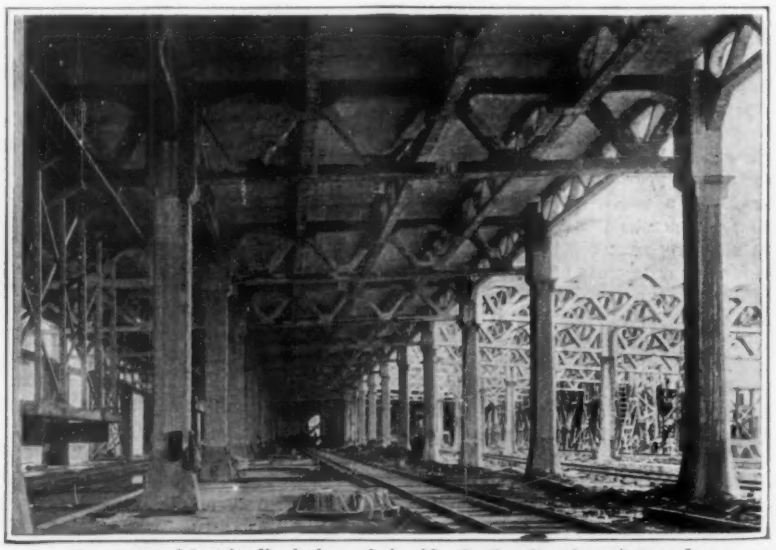
At first, Pier 6 ranked as a "proposed" piece of construction. It is so marked on a general plan dated May 15, 1916. Today, less than four years later, it is a work that has been completed for a number of months. And this, despite the great war. So, it will not be wise for one to limit the possibilities too sharply.

Pier 6, like all the others, is of a size permitting a 1,000-foot ship to lie alongside on either side. The width of a pier, measured perpendicularly to the axis and sides, is 150 feet. The intervening slips have a similar width of 300 feet.

Naturally, the most important feature of a pier is

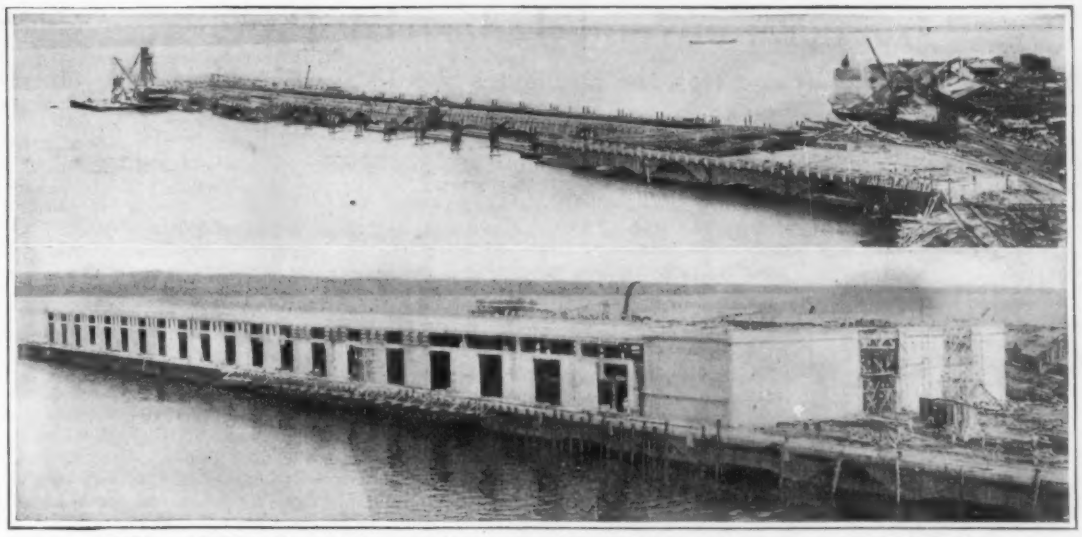


View of a portion of pier No. 6, showing the reinforced concrete girders and arches to support floor system



Interior and longitudinal view of pier No. 6, showing the reinforced concrete roof construction

its foundation. At both the Atlantic and Pacific terminals, the engineers have favored the use of hollow cylinders. These cylinders consist of tubular sections set one upon the other and either forced down by pressure or excavated from the inside. The cylinder resting at the desired depth and clear of soil would now be filled with concrete. The result is a substantial concrete pier having a tremendous supporting power and being in quite a distinct class from the ordinary bearing pile. For Pier 6, about 9,677,000 pounds of steel went into the cylinders. This is an enormous amount of metal.



Before and after: General views of pier No. 6 at Cristobal at an early stage of construction and when nearly completed

The cylinders were, in general, 6 feet in diameter. The material came flat in plates ⅜ inch thick. These were locally rolled to cylindrical form at the Cristobal shops. When in place, the total lengths of piers amounted to 22,610 linear feet. This is over 4 miles. If stood, one upon the other, the topmost pier would be at a higher level than the summit of the great Alaskan peak, Mt. McKinley. Out of the cylinders came 14,382 cubic yards of spoil; into them went 22,000 cubic yards of concrete.

The big 6-foot piers were spaced longitudinally 45 feet apart; and 26.5 feet apart, transversely. This spacing was in contemplation of a structural steel floor system. When, however, the bids were examined for this steelwork, the amount that it would be necessary to pay was found to be so great as to be just about prohibitive. It was now proposed to change over to reinforced concrete in an effort to bring down the cost. But the span of 45 feet was a very considerable one for reinforced concrete construction. At first, it was proposed to use "continuous arch-shaped girders with steel tie-rods in alternate bays, designed to take either compression or tension." It was, however, found desirable to employ "arches in the same bays as the struts, but elsewhere to use ordinary haunched girders."

But the design of a thing does not necessarily include the means of carrying out that design. Great concrete girders alternating with great concrete arches proved satisfactory as a thing proposed. Upon calculation, it was found that the necessary forms with their load of fresh concrete would, for a girder, weigh about 350,000 pounds, and for an arch about 250,000 pounds. A very considerable problem was involved in providing support during the setting and hardening of the concrete. Finally, the decision was reached to employ long second-hand steel girders of the bridge type to carry the forms and fresh concrete of the concrete girders. Smaller steel girders were used to carry the forms and concrete for the arches. The steel bridge girders were set upon steel H-beams which were laid to extend from pier to pier in a direction transverse to the axis of the whole structure.

Further difficulty arose in connection with the concrete itself. This was a 1-to-4 mix of concrete and

(Continued on page 142)

Chicago's Giant Bascule Bridge

THE remarkable thing about the record-breaking bascule bridge that has just been completed over the Chicago River on the St. Charles Air Line at Sixteenth Street, Chicago, is that it is to be moved bodily 400 feet to the west as soon as the project for straightening the Chicago River shall have become a reality.

This bridge is a monster of its kind. Two mammoth concrete counterweights have been provided, each weighing approximately 885 tons. These huge slabs are 5 feet 7 inches thick, 60 feet high and 37 feet wide. They have been built around the structural steel members of the counterweight trusses supporting them. In addition to being thoroughly reinforced they are further strengthened by 3 inches of expanded metal placed two inches from the outer faces of the concrete. Instead of the single counterweight, as is often the practice in bridges of this type, two slabs were employed as according greater leverage.

Plenty of leverage was required as into the bridge went more than 1,500 tons of structural steel. The new double track bridge is 260 feet long between end bearings of the moving leaf and provides a clear channel for navigation 200 feet wide at right angles to the channel. The bridge crosses the river at an angle of 63 degrees and replaces a double track horizontal swinging draw-bridge nearly 300 feet long. The new bridge is supported on cylinder piers that extend down to bed rock. Each pier is in reality a pair of cylinders braced together by concrete girders.

To open or close this bridge requires but one and one-half minutes. This is done by means of straight racks bolted to a pair of operating struts, one pivoted to the end post of each truss, which are engaged by operating pinions located in the portal of the counterweight tower. These pinions are driven through an equalizer and reduction gears by two 150 horse-power alternating current motors on a 440-volt 3-phase 60-cycle circuit, all located in a stationary cabin built above the overhead railroad clearance line. A 45 h.-p. gasoline engine has been provided for emergency drive.

To handle a bridge of this extraordinary size it was deemed advisable to use an air buffer in addition to the oak bumping blocks usually employed. A piston rod 6 feet 3 inches long held in extended position by coiled springs has been provided. When the bridge nears the limit of its opening the rod comes in contact with a short bumping girder fastened to the inclined post of the counterweight tower. Thus the compressed air gradually checks any further movement of the bridge after the power has been cut off and the motor brakes called into action.

To take the new bridge to its new position it will be necessary to revolve it intact on a circular track and rollers through an angle of 160 degrees on to a new substructure that is to be built to accommodate the river channel after it has been straightened. Provision has been made to meet this emergency successfully.

Italy and the Quicksilver Supply

THE Monte Amiata mercury mines of Italy were controlled by German capital at the outbreak of the war and were seized by the Italian government on its entry into the conflict. With the annexations of former Austro-Hungarian territory the Idria mines formerly belonging to the Austrian state became the property of the same government. About half of the world's production of mercury is now assured to Italy.

The gigantic bascule bridge recently completed at Chicago, and a graphic comparison of its upward run with a 20-story building

Coöperation and Industrial Progress

An Opinion as to Why and How the Employees Should Share in Plant Management

By Cyrus McCormick, Jr.

IT is not the purpose of the present paper to analyze completely all of the various causes entering into the industrial unrest that has swept over the world as a result of the war. Many conferences have given their attention to this subject and have adopted findings differing not so much in essential features as in the details of the plans suggested to ameliorate existing conditions.

It has been suggested that the difficulties under which employers and employees are operating are due to the nervous tension, resulting from the war; to the high cost of living; to the fear of unemployment; to insufficient wages; to desire to share in the profits of industry; to a revolt against the old order of things whatever that may have been, etc. Each critic has, however, been more or less in agreement that the war taught nations once and for all time that individual workmen must be regarded as human beings. They are, to be sure, an element in production just as is the management, but the time has gone by when human labor can be bought and sold as are machines, tools, or raw materials. This lesson has long ago been learned by the majority of American employers, among whom the more liberal have for years been taking every forward step suggested to bring about a humanizing of industry. The results of the war, however, have made radicals out of many conservatives until at the present time some of the older European nations have, in theory at least, gone ahead of the United States. The man, as opposed to the machine, has the power to think, and is endowed with a soul. He is at last seeking recognition of this fact.

In agreement with many critics of the present industrial situation; I believe that the most significant feature in labor conditions of the day is the expressed desire of labor to share in the management of business. This desire has taken on various forms in different parts of the world, the Bolshevism of Russia being merely the idea carried to an absolute extreme. The underlying significance of all these movements is the final realization that the relations of employers and employees must from now on be formed on something besides a cash basis. The workman is as interested as ever in his wages and in his hours, but he is asking for more. Sometimes the demands are not well understood even by those putting them forward. What the workmen really want is self-expression. They are asking the right to discuss and share in the adjustment of matters affecting their own interests.

Many employers in this country, sensing this situation, are admitting the right of their employees to discuss in joint conference, matters affecting the mutual interests of Capital and Labor. This, of course, has involved a recognition of the principle of collective bargaining. Economists of the older school tell us that collective bargaining is detrimental to the best interests of the employees and that any artificial interference with wages will result in an artificial attempt to regulate prices. They claim that values are regulated by economic laws. This, of course, is true to a certain extent, but on the other hand it can be argued that collective bargaining is an aid to humanity and that it allows other economic laws to operate which might otherwise be held in abeyance. Not many years ago the doctrine of "*caveat emptor*" ruled every economic transaction and the business world was permeated with the ethics of David Harum. Just as that doctrine has vanished, so now is vanishing the fear of collective bargaining, and we find ourselves not only admitting the right of workmen to participate in the determination of working conditions but also discussing how this right may be most surely exercised. The method finding most favor in this country can perhaps best be classified by simply calling it Employee Representation.

Reasons for Adoption of Employee Representation

Syndicalism has made such rapid strides in eastern Europe that some men, not recognizing the fundamental solidarity of the American people are afraid that this country is about to deliver itself to Bolshevism; therefore they are seeking to head off this unrestrained development and to provide a saner method by which the legitimate desires of the workmen for self-expression may be granted without at the same time completely ruining our present industrial fabric. Men of this opinion argue that the laborer has a right to speak for himself, and wish to give him this right before he resorts to revolution to obtain by force what he may think is being withheld from him. They believe discussion in an open forum cannot but bring results and that through efficient coöperation Capital and Labor, working together, will avert any possible danger of anarchy.

There is a close parallel existing between the movement in favor of employee representation and the growth of democratic government. Europe in the eighteenth century considered Frederick the Great's government to be nearly ideal. Later thinkers have called his government a benevolent despotism. Frederick was autocratic as any Czar and his form of government a despotism; but because he tried to do right and interpret in the fairest sort of way the desires of his people, his despotism was benevolent. Now until recent years our industrial system was also a benevolent despotism. Large employers in this country and abroad instituted welfare work; started systems of insurance and compensation; made the conditions of their woking people as pleasant and safe as possible; but everything that was done was paternally imposed from the top and did not come as a result of the expressed desire of the great body of employees. This system was benevolent, to be sure, but it was nevertheless despotic to a great extent. Just as benevolent despotism in politics has given way to a great democracy wherein the governed have every right of self-expression, so in industry we are now finding the old system being set aside. Now the employee is not only given the right, but is urged to accept it, to sit on an equal basis with his employer and decide every question which affects his interests. Industry is becoming democratic.

OPINIONS may differ as to whether employees may fairly demand a share in the management of the business. That they are very generally demanding this, however; and very generally getting it, admits of no argument. And when a representative of big business interests like Mr. McCormick, in publicly addressing a gathering of his peers (at the recent meeting of the National Safety Council in Chicago) comes out boldly in favor of employee representation and tells why he is for it, his remarks claim the serious attention of all. We give on this page Mr. McCormick's address in question, with some abridgement.—THE EDITOR.

It is easy to point a finger of scorn at our present civilization and condemn it as being overly materialistic. Metaphysicians from Aristotle to the present day have argued against materialism. Phrasing their thoughts in the vernacular and adapting their theories to modern times, we may say that we must find some new cause for our existence besides the worship of the almighty dollar. The joy of doing things rightly will in the end give men a more real satisfaction than the material results of their efforts. Applying metaphysics to employee representation, we may describe it as a concrete effort to introduce moral right into industry. It will be many generations before materialism vanishes from our daily life but surely employee representation is a step in the right direction. Idealism, after all, is something the world would do well to analyze as a necessity of today rather than of the Hereafter.

Looked at superficially, employee representation is expensive. It costs a certain amount of money to pay the added salaries, to do the clerical work involved, and the like; but those employers who have had the best experience say that it is really economical and efficient. They believe it pays; they believe the added interest a man must have in his work when he knows he has a share in the control of it, will go a great way toward bringing about the final efficiency of production which must be secured if the present pace of manufacturing is to be maintained. Scientific management has just one more step to take. It must become endowed with soul in order to become more efficient; and its savings must depend not upon force or will, but upon the consent of the governed. The war has proven that democratic society, while superficially less efficient than autocracy, is in the end far stronger in the face of the most awful competition human ingenuity can devise.

Fundamental Principles Underlying Employee Representation

There are certain fundamental principles underlying any plan of employee representation. In the first place, there must be full representation (here I quote from the plan of my company) "on all questions relating to working conditions, protection of health, safety, wages, hours of labor, recreation, education, and other similar matters of mutual interest to the employees and the management." When we came to draft that clause in our plan we decided to make it as broad as possible. We felt the necessity of allowing the platform to include discussion on every possible subject of mutual interest. Those who may be considering undertaking such a plan must make up their minds to go into it completely or not at all. The plan must be broad if it is to be democratic, and if it is not broadly democratic it cannot succeed. The time may come when employees will wish to share in the executive management of a business. This, however, will be a matter for generations of education and development; and at the present time no one except the syndicalists is demanding participation in the management except as it affects the interests of the men.

A truly democratic plan of employee representation must involve joint conference between men and management. Without entering into a discussion of who may constitute the parties to industry, I may take it for granted that they include Capital, Labor, and the Consumer. As long as these three interests remain unacquainted with each other they must be mutually suspicious. Under employee representation we cease to fear discussion. We believe that if any subject can be brought out into the open where it can be tested by the clash of men's minds and where honest opinions are exchanged in free and happy discussion, a right solution cannot be long delayed. The fundamental point is to get together; to talk things over; to debate them; to understand each other's intelligently expressed opinions—and then the solution will come by itself.

The third point is to have sufficient representation. The numerical unit of representation will largely be dependent upon the character of the business in question. Small factories or offices may have one representative to each 25 or 30 employees. Large factories may have one representative to every 200 or 300 men. Suffice it to say that the constituency must be small enough to give each voter some contact with his representative. On the other hand, it must not be so small that the council committee, or legislative body is so numerous that there can be no real discussion between the representatives of the men and the management.

There must be an easy, secret method of election to give the men absolute freedom in choosing their representatives. The War Labor Board at first thought it advisable to hold the elections outside the plant for fear of there being some interference on the part of the management. Subsequently, however, they reversed this practice. In no case, to my knowledge, where such a plan is in operation, has any employer tried to direct the voting. It has been found advantageous to all concerned to allow workmen just as much freedom in choosing their industrial representatives as they already possess in choosing their congressmen or aldermen. Only if the choice is absolutely free will the appointed representatives of the management be able to get in touch with the real opinion of the men.

The plan must provide for an easy method of appeal to the highest authority in the company. Red tape must be conspicuous by its absence. If a workman has some grievance which he cannot settle directly with his foreman he may call his representative into conference. If these three reach an agreement the matter is then settled. If not, the employee representative may take the matter straight to the superintendent of the plant. If the matter is then not settled it should go easily and quickly to the Works Council,

(*Continued on page 142*)

Salvaging Stranded Food Fishes

PROBABLY many individuals on reading the title of this article will have a mental picture of a band of fur-clad Esquimaux or of hardy New England fishermen gathered on and around a carcass which has been cast up on the shore. Few will realize that the work of salvaging stranded members of the finny tribe has a far different meaning to the United States Bureau of Fisheries.

Each spring the Mississippi and its tributaries, when in flood, roll down tremendous volumes of water which frequently overflows banks and levees and spreads out over the adjoining country. As the floods subside and the excessive run-off recedes to normal river flow, many inland lakes and pools are formed, cut off from communication with the river. In these landlocked sloughs and pockets are found literally millions of fish, destined to die a lingering death following the drying up or freezing of the temporary waters in which they have been caught. So the Bureau of Fisheries man decided that here was an excellent opportunity for practical conservation.

The work of salvaging these food fishes by the Bureau has been going on for a number of years, but during the period from July 1 to November 18, 1918, the results accomplished have far outshone those of any previous corresponding period. During these months the number of food fishes salvaged by the Bureau reached the record-breaking total of nearly 55,000,000—more than enough to supply every person in the United States with a Friday fish dinner and have enough left over to feed the cat for a week; or, if placed end to end, to make a silvery band of flapping fish nearly half the distance around the globe. Here they are, lined up for inspection:

Bowfin	98,000
Buffalo	2,539,265
Carp	19,451,685
Catfish	12,400,515
Gizzard shad	25,000
Black bass	424,670
Crappie	15,682,015
Rock bass	5,660
Sunfish	1,034,220
Yellow perch	2,350,510
White bass	8,790
Drum	18,975
Pike and pickerel	301,505
Shiners	300,000
Miscellaneous	317,020
Total	54,957,830

Some idea of the number of fish rescued daily from desiccation or freezing may be gained from the statement of the Bureau that the crew of five men available in October for the seining work on the Illinois and Kentucky sides of the Ohio River averaged 25,000 to 50,000 fish.

Especially equipped seining parties are sent out by the Bureau, operating from Minnesota to Mississippi, with several local headquarters. The following statement shows the number of food fish rescued by the employees of these stations during the period of four and a half months:

Homer, Minn., and substations	344,958,030
Bellevue and North McGregor, Iowa	17,624,180
Cairo and Meredosia, Ill.	3,106,020
Friar Point, Miss.	269,600
Total	54,957,830

Mr. C. F. Culler, superintendent of the station at Homer, with nearly 50 per cent of the total salvage to his credit, is the original piscatorial prince when it comes to lifting a member of the finny tribe out of a landlocked pool and putting him back with a grateful wiggle into a running stream. This was Mr. Culler's first season at Homer, but with a favorable field for operations and taking full advanntage of the situation, he smashed all previous records in helping to conserve the Nation's supply of food fishes by salvage. On only a very few days during the salvage period was his crew of 26 men unable to gather in their daily stint of several thousand pounds of fish, so that he was able to beat the last year's record of 8,250,000 fish at this station by something over 18,000,000.

Mr. Culler's crew worked in the sloughs and pockets along the Mississippi River between Wabasha, Minn., and Lynxville, Wis., and practically all the rescued fish were put back into the river, it being stated by Mr. Culler that less than one-third of 1 per cent were shipped to inland lakes.

That this conservation work is practical is indicated by Mr. Culler's asertion that it is possible to save more fish in this way in a single day than could be bred in a year at the Homer station. "Carp predominate," said Mr. Culler, in Ocotober, "and are in great demand in the eastern markets at present. From many places they are shipped alive in refrigerator cars, and at present are commanding 28 cents a pound."

The food-saving value of this unique conservation work is enormous, and fully justifies the statement of the Bureau of Fisheries that the cash value of the fish rescued, at the rates charged by commercial hatcheries, exceeds the total appropriation of the Bureau for fish-cultural work.—*Hugh A. Brown.*

The Reversal of Image in Photography

WITHOUT going into details, let me say that the reversal of image in photography is understood generally to refer to an exposed plate or film which emerges from the developer a positive instead of a negative. This phenomenon may be produced artificially by great overexposure and subsequent chemical manipulation in the developer. Little practical value is attached to the process although it is of scientific interest. However, when the reversal of image occurs in the ordinary day's work of the commercial photo-finisher and appears among the films of the average amateur photographer without apparent cause, the subject becomes of general interest.

During the past summer I had occasion to take a renewed interest in the subject because of an unusual case which was reported in the columns of *The British Journal of Photography* by Mr. W. Binns. Briefly, according to Mr. Binns, a batch of eighty dozen 3¼ x 5½ plates—all out-of-door subjects—was placed in the same developer in regulation developing-tanks. At the expiration of the allotted time for development, all the plates except twenty-five turned out well. With regard to the twenty-five, these proved to be *positives* instead of negatives. These plates were slightly fogged but they would have made fair prints had they been negatives instead of positives. A subsequent batch of eighty dozen plates included two dozen positives and the rest were good negatives. Since these plates were developed identically it is unaccountable why some should be positives and others negatives. In fact, one plate that contained two different exposures was half positive and half negative. To this was added the experience of Mr. E. A. Maitland who reported that he had an old plate which shows a negative at one end which latter merges into a positive at the other. However, in this case the cause of reversal was found to be light-leakage in the plateholders.

In the course of further discussion of the subject, I came upon a still more remarkable case of this interesting phenomenon. An amateur photographer's six-exposure roll-film was developed with many others in a tank at a well-known photo-finisher's in Boston. When this roll of film was removed from the developing-tank, it was found that exposures 1, 3 and 5 were negative and that 2, 4 and 6 were positive. Two authorities in photographic physics were consulted, and, after a careful examination of the film, they came to the conclusion that this particular phenomenon was produced by carrying the camera about opened and with bellows extended. The owner of the film was questioned and it was proved that the physicists were right with regard to the cause; but they could not determine the exact reaction that took place on the film.

Briefly, the owner of the film visited a local point of interest on a bright sunny day. He opened the camera and made the first exposure. Then, with the camera still open and the film turned to the second exposure, he strolled about in the sunshine until he made the second snapshot, after which he closed the camera. Later, he made exposure number three, and carried the camera exposed to the full glare of the sun with the film turned to exposure four. It was exposed and the camera closed for the second time. Exposures five and six were made in a similar manner before the camera was laid aside for the day. The theory advanced was that a certain amount of light—imperceptible to the human eye—and the radiation of heat in and around the camera penetrated to the sensitive film and produced overexposure which, according to reliable authorities, is conducive to reversal. The first picture was an ordinary instantaneous exposure. The second was also; but before exposure number two was made, the sensitive film had received the action of light and heat due to the camera being carried about exposed to the full glare of the sun. This same reasoning applied to exposures four and six. Whether this theory is sound or not, has not been decided. At all events it is plausible and should furnish a basis for others to work on in the endeavor to account for the phenomena.

My object in bringing the subject to the attention of readers of the SCIENTIFIC AMERICAN is not to offer an explanation but in the hope that parallel cases may be brought to light which may lead to a definite solution of the problem. I can assure the reader that there are many amateur and professional photographers throughout the world who would welcome further information on the subject. Let me repeat that the practical interest of the phenomenon does not lie in how it may be produced; but why it occurs at all under ordinary conditions, and without intent on the part of the commercial photo-finisher or the average amateur photographer.—*A. H. Beardsley.*

The Skin Has Spots of Pain

MAN'S mind includes not only the highly complex organ—the brain—but a wonderfully intricate transmission system of nerves, feeding the brain centers and executing its commands. The surface of the skin is one of the most delicate and supersensitive receiving organs of the mind. Seemingly very simple in its function, an examination of its complexity reveals a great deal of interesting information.

Roll up your cuff and on the under side of the forearm, with a soft lead pencil, mark out a square about an inch in size. Cool the blunt end of a needle and explore the surface of the skin included in the square you have marked out. You will find that there are certain points that will respond with definite flashes of sensations of cold. You will discover that other points on the skin will yield no such sensations. Mark the places where the cold spots are found with the pencil. A queerly arranged temperature map will result.

Now warm the blunt end of the needle slightly above the temperature of the skin. Apply it within the same square and you will find that certain spots, known as heat spots, respond by giving a sensation of warmth. Mark these spots with red ink, as they are distributed where the cold spots are not. Still there remains space where neither heat nor cold is felt.

With the blunt end of the needle, neutral as regards temperature, probe gently the surface of the square. At certain spots there is a feeling that there is a grain of sand beneath the skin. These are pressure spots and are used by the brain to discover the mere presence or contact of an object. Mark all of these spots that you can find.

With the sharp point of the needle jab the skin, going over the whole square. Strangely enough some spots on the skin do not feel any pain while others do.

Heat the point of the needle red hot and apply it slightly touching the surface and you will observe that there is no sensation of warmth, but of pain only. A needle immersed in ice water and then applied also gives pain instead of cold.

This series of experiments has a great deal of interest in itself, but if studied to determine the cause of the diversity of sensations, yields a great deal of scientific information about the operations of the human mind. Leading from the spinal cord are two great pairs of nerve-bundles, whose branches extend down the arm and again separate into millions of microscopic fibers. The highly sensitized ends of these fibers, or nerve endings, approach the surface of the skin. It seems that certain groups of these nerve-endings have definite functions of their own—some to pick up sensations of heat, others cold, pain, and pressure. When the skin comes in contact with objects in the outside world, each nerve-ending takes from that object the quality that it wants and from thence it is instantaneously conveyed to the brain where it is recognized.

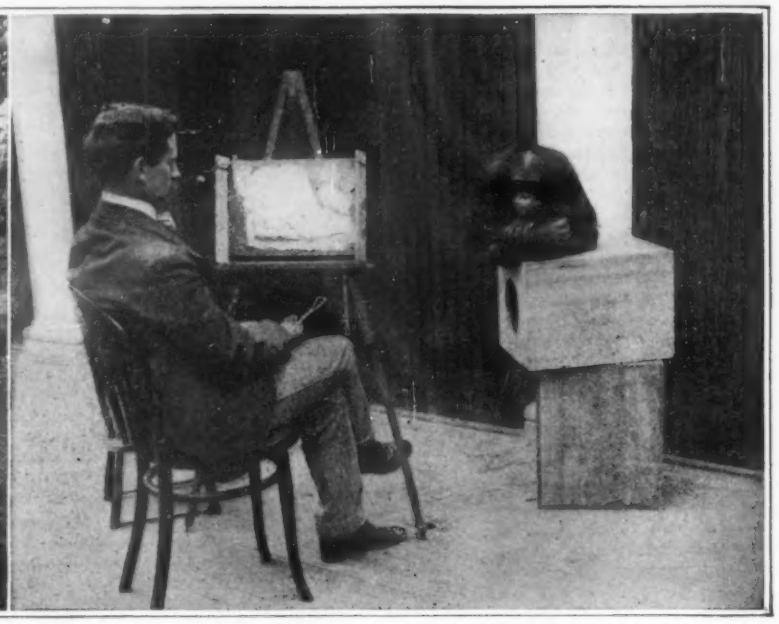
It is interesting to plot these nerve-ending maps on several parts of the body. The varying distribution of the different spots will surprise you. On the lobe of the ear, you will find scarcely any pain spots—a needle may be pressed clear through with no sensation of pain. The ends of the fingers are almost completely covered with pressure spots. The foot is extremely sensitive to cold. The eyeball is supersensitive to pain, but has no heat and cold spots.

Perhaps, now, you can see what an interesting study could be made of nerves that pick up the more highly complex sensations of sound, taste, color and smell.—*D. H. Colcord.*

Manganese Economy

WE are beginning to get information as to practice in certain countries abroad which enabled them to conserve raw materials of military importance. It seems that the practice of pre-melting ferro-manganese in electric furnaces specially designed for the purpose enabled the saving of 25 per cent of manganese as against the usual practice of adding solid ferro-manganese to molten steel. It is now believed that when solid ferro-manganese is added it is only partially absorbed by the steel and at least 30 per cent of the manganese content is lost by oxidation.

Paul Herzel painting an elk from a live model at Bronx Park



The Zoo helps A. P. Proctor in his study of an orangutan

Wild Animal Models at the Zoo

How New York's Painters and Sculptors Work from Nature in Their Representations of Wild Life

By William T. Hornaday

Photographs copyright by the New York Zoological Society

FOR the twenty years beginning November 9, 1899, the day the Zoölogical Park was first opened to the public, the Zoölogical Society has welcomed all animal painters, sculptors, illustrators, investigators and students. No permits are necessary for anything save the photographing of wild animal models; and all keepers have standing orders that every man is to do everything possible to facilitate the work of painters and sculptors. Even at the best the work of the animal craftsman is difficult, many times it is full of annoyances, and often it is climatically uncomfortable.

For the animal craftsman we have no closed hours. They can come in at seven-thirty in the morning, if they don't oversleep, every day in the year, and they can work until dark if they have the endurance. When a roaming beast needs to be penned up for close-up work, we pen it up.

Now, all this coöperation on our part is nothing deserving of thanks, or of anthing more than appreciation. It is our duty to do these things, and they come as being all in the day's work.

Naturally, the magnificent wild animal models of the Zoölogical Park have stimulated the sculpture and painting of wild animals. It is a cold day when there is not at least one painter or sculptor at work, and when business is brisk there may be half a dozen. Never, however, in all these 20 years have I known the animal sculptors and painters of New York to get together to eat or drink something in company, or even for a talkfest. They are not gregarious animals, when it comes to associating in kind. A complete list of the men and women who have utilized our wild animal models and the park as their studio would be a long one.

It was the painters and illustrators who first began to use our animals, and as I recall the past the first ones who worked in the newly-born Zoölogical Park were Carl Rungius and Ernest T. Seton. Mr. Seton's studies were chiefly of bears, wolves, foxes, otter, beaver and prong-horned antelope.

Mr. Rungius has painted in the park a long list of our largest and finest American animals, and has executed two portraits of "Sultan" and one of "Dinah," the gorilla, for the Zoölogical Society. I think there is no species of North American big game ever in our possession that Mr. Rungius has not painted in our atmosphere. His masterpieces have been of mountain goat, mountain sheep, Alaskan brown bear, polar bear, musk-ox, elk, mule deer, American bison, elk and prong-horned antelope. Some day the collection of Rungius paintings in the possession of the New York Zoölogical Society will be the most famous small collection of paintings in all America; and that is all there is time to say about them at present.

Mr. A. Plumister Proctor and Mr. Eli Harvey have done a really "immense" amount of work in the park, and it is a source of sincere pleasure to us all that they have left their records in enduring sculptures on the finest animal buildings of our institution. Our architectural sculptors of wild animals began with Mr. Proctor's striking figures of orangutans, kamadryas baboons and mixed monkeys on the Primate House. While this work was in progress, Mr. Harvey was invited from Paris to do a really superb series of sculptures for the Lion House. His work was done so faithfully and so well that today it stands fairly beyond the reach of hostile criticism. No one—so far as we know—has any fault to find with the four sitting lions in marble that guard the doors of the two entrances of the Lion House, which certainly strike a happy medium between the demands of practical architecture and zoölogical realism.

Many of the largest and most noted animal sculptures now to be seen in our leading American cities were modeled in the Zoölogical Park. Proctor immortalized old "Sultan" in the four colossal lion figures, each 12 feet long, that recline at the base of the McKinley

Mr. Proctor working on head of Indian elephant in front of the elephant house

monument in Buffalo. Our finest bull bison was modeled by Mr. Proctor in a little house that he built for himself for winter use in the buffalo corral, and the great bronze buffaloes that command the approaches to the bridge over Rock Creek, in Washington are the result.

On the south side of our Elephant House, Mr. Proctor's life size heads of our Indian elephant, "Gunda," are most striking adornments. According to the regulations, Mr. Proctor's life-size model in plaster was to have been cut in stone by the mechanics of a contractor; and this was done, and turned over as "finished." The result was—two blocks of stone totally devoid of the vital spark of life.

And then, contrary to the natural requirements of the game, Mr. Proctor threw off his coat, donned overalls, climbed upon the scaffold and with mallet and chisel wrought upon those dead blocks of limestone until the living elephant stood forth. It was wonderful to see the spirit of old Gunda come forth from under that chisel, like a dim likeness being sharpened and made a "close-up" on a screen.

The African elephants, on the north entrance to the Lion House, were modeled by Mr. Charles R. Knight, and fortunately for him, the workmen were successful in catching and translating the spirit of his model, by which he was saved from the rough experience of Mr. Proctor. Those two pairs of elephant heads strikingly establish forever the fact that there is not the slightest necessity or excuse for departing from the form and texture of the living model in sculptured wild animals that are intended as adjuncts or ornaments for great architectural work. In fact, the strictly architectural lions in front of the New York Public Library have served their full purpose in demonstrating the long-smouldering aversion of the public to grotesque wild animals in public places.

Many beautiful sculptural groups of wild animals have been produced in the park and today stand in obscure cabinets, unknown save to the sculptor and the director. There are some that deserve to be born in the large, and in bronze or marble. I have particularly in mind a fine group of American bison by Miss Anna Vaughn Hyatt, whose life-size bronze statue of old "Sultan" adorns Dayton, Ohio, and a charming group of mountain goats by she who once was Margaret Weischman.

One of the most interesting of Zoölogical Park animal painters is Paul Herzel, who works month in and month out on elk and deer. The park is literally his studio, and when he is at work visitors enjoy the rare treat of seeing a real artist at work on a real painting, not a sketch in oil, but which they know will presently be finished in the park and taken straight away to receive its gold frame.

Danger!

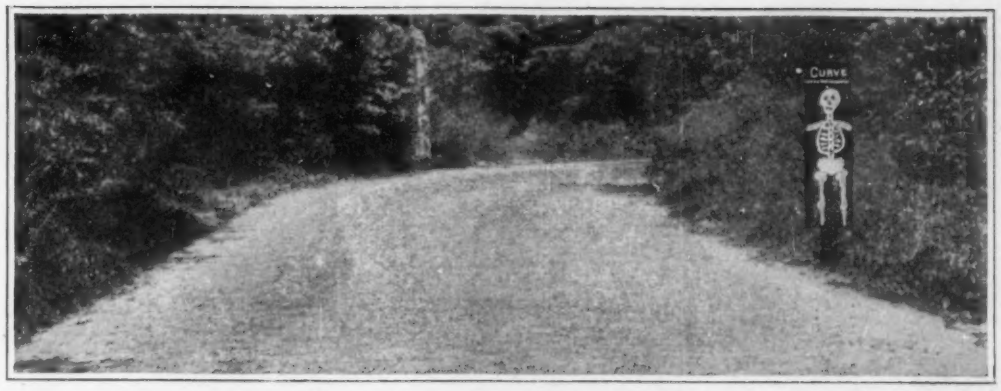
THE physician knows better than most men how the majority of us fear death, and one of the medical fraternity, Dr. Theron W. Kilmer, of New York City, has recently devised a warning signal which he confidently believes will go a long way towards lessening grade-crossings catastrophes—using to this end an emblem or signal calculated to arouse great apprehension.

As statistics show, accidents at railway crossings claim thousands of lives annually, which are sacrificed either because of heedlessness or the ineffectiveness of the run of signals commonly employed. All too often pedestrians and autoists fail to hear the cautioning bell, and this is particularly so if the man at the wheel of a car has his hearing deadened by the noise of the motor's engine. Time and again, the "joy rider" and others of a kindred careless tendency ignore crossing lights and take a peculiar pleasure in rushing by the flagman unmindful of the fact that his mission is to save them and not to interfere with their proper progress.

As Dr. Kilmer says, denial to the contrary, "People do, indeed, fear death, and the risks they take in inviting disaster are not risks, as they understand them. They think themselves secure and do not realize their peril until it is too late." Therefore, this physician has produced a safety device which suddenly confronts the venturesome with a very realistic vision of the symbol of death—a skeleton which is vividly in evidence at the desired place or moment either by day or night.

This is achieved by depicting upon sheet metal, coated in dead black, a life-sized skeleton by means of luminous paint, which shows white by day and ominously lurid at night. In the case of a railroad crossing, the warning sign would ordinarily lie concealed and below the highway level in a suitable recess, and would be swung vertically into place by the functioning of a small electric motor which would be called into action by the approaching train closing the operative circuit. Similarly, after the tracks have been cleared, and a second circuit closed, with motor reversed, the effigy sinks from sight.

The inventor suggests that a similar startling warning be placed at any dangerous curve; the sign being continually in evidence and attached to a post placed at the side of the road far enough in advance of both approaches to the turn. Dr. Kilmer is satisfied that in this way it would be possible to drive home quickly and positively to the autoist's mind a realization of the hazard ahead.



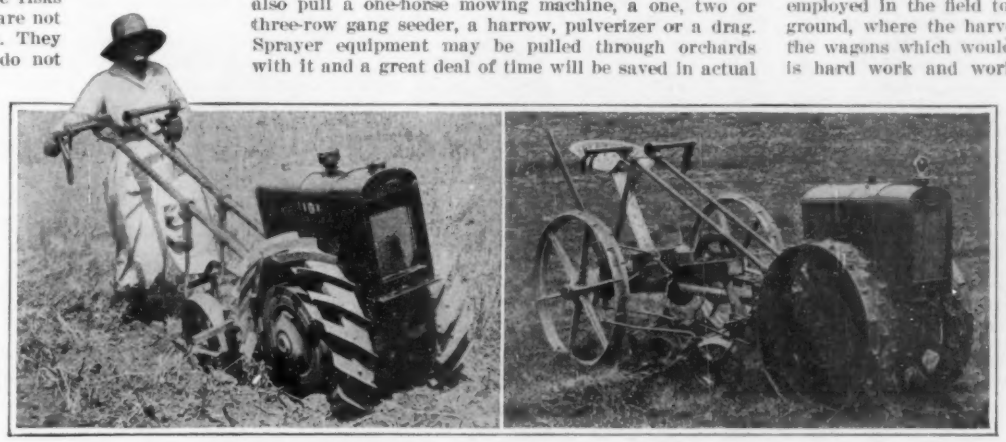
A sign for a dangerous spot on the road that cannot be overlooked or misinterpreted

A Small-Space Tractor

A TRACTOR specially designed for use on small farms has been recently introduced by an Indianapolis manufacturer of gasoline engines. Weighing only 700 pounds and only 84 inches in length this tractor will do practically everything that a horse will do on the farm and may be used as a stationary engine wherever it may travel under its own power.

A one, two or three-row cultivator may be used with this tractor as well as a small turning plow for breaking ground in a garden or truck patch. It will also pull a one-horse mowing machine, a one, two or three-row gang seeder, a harrow, pulverizer or a drag. Sprayer equipment may be pulled through orchards with it and a great deal of time will be saved in actual spraying operations. At the draw bar this tractor develops one and one-half horse-power and used as a stationary engine will develop four horse-power on the belt.

A one cylinder, 4-cycle motor is used in this tractor. The gasoline tank has a capacity of 1½ gallons. The tractor has a positive clutch control for each drive wheel. By releasing one clutch and permitting the other to work the tractor will pivot on one wheel. The width of the machine is 17½ inches and is 3 feet in height. It has one speed forward with a range of one to four miles per hour. The speed recommended for plowing is 2½ miles per hour. It is equipped with interchangeable bull wheels with quick detachable rims.—*Allen P. Child.*



New hand tractor in use for truck gardening (left) and with mowing machine (right)

A New Method of Filling the Silo

A NEW method of filling the silo has been perfected. With this new method two or three neighbors can fill their own silos with less delay than where several have to club together as in the old way.

The old way, with the cutter and blower combined at the silo and a corn harvester in the field, necessitated a great deal of help—almost as much as at thrashing time; and in most communities many farmers had then to exchange work in order to insure each other of sufficient help.

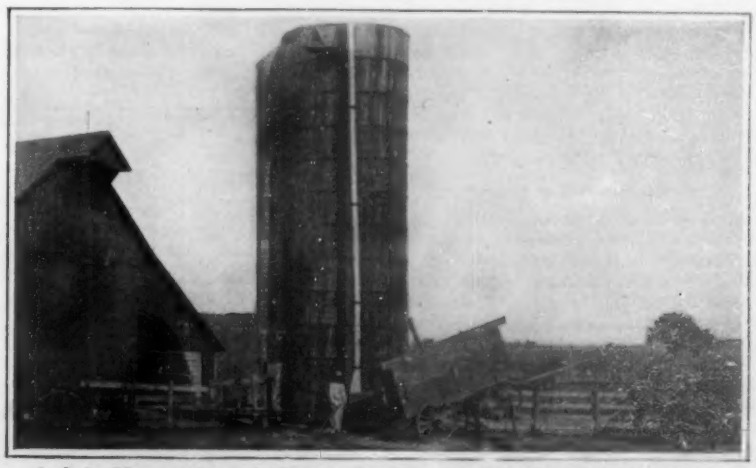
The practical objections to this old way were that there was a great loss of time that could not be profitably used. Belts would break, cutter knives would get dull, nuts would come off, the engine would fail to keep up power and a hundred other things might happen. In the event that an accident did happen, all of the men were laid off and seventeen men and the same number of horses laid off, an hour counts up a great deal of labor and expense as time is money these days. Moreover, twine for the harvester was an added expenditure and three or four pitchers were employed in the field to "pitch" the bundles from the ground, where the harvester had dropped them, up to the wagons which would take them to the barn. This is hard work and work that most men are glad to see done away with. Also, the silo was filled so fast that it did not have time to settle while filling was going on. This meant that after the silo was filled, it settled about six feet and that the whole of its capacity was not utilized.

The new way consists of a corn harvester to which is attached a cutter, the whole mechanism being run by a gasoline engine. The cut corn is delivered over to a wagon with a triple or quadruple bed on it. It will be seen that no twine is needed and furthermore, a minimum of engine horse-power is used for the fact that not more than three stalks are going through the cutter at any one time. The stalks are conveyed up by the usual conveyor chains and when they get into position just in front of the cutter, the top falls forward and the stalks are fed into the cutter butts first. The machinery being run by power, it is possible for three horses to draw the outfit easily.

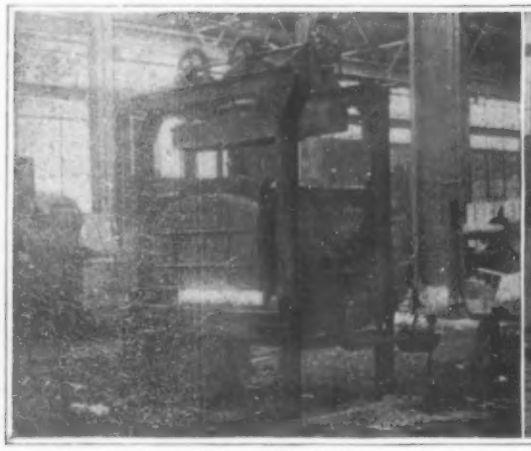
Where the silo is being filled, there is a blower, a hinged conveyor, and a wagon elevator such as used with the ordinary corn elevator. The conveyor swings up against the side of the blower allowing the wagon to be drawn alongside the blower with the front wheels upon the corn elevator. The blower can be run by

(Continued on page 144)

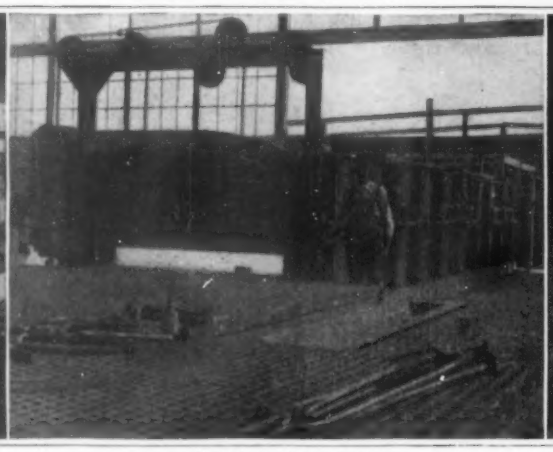
The harvester that delivers cut corn from the stalk to the wagon—



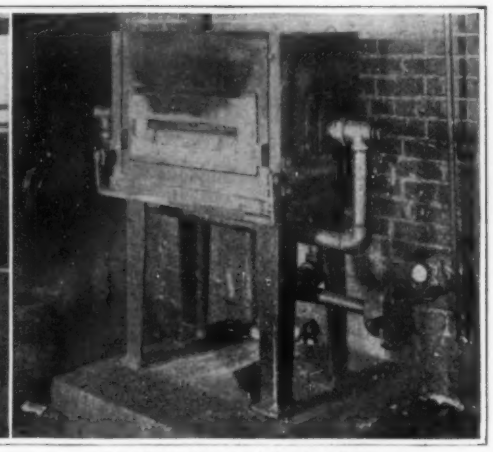
And the blower that packs it away in the silo against the coming of winter



Gas-fired forge for shipliners



Gas-fired plate and angle furnace



Standard gas-fired forging furnace

Gas and Steel

Some Facts and Figures on the Heat Treatment of High and Low Carbon Steel

By W. A. Ehlers, M.E.

IN the following considerations given to the subject of the heat treatment of low and high carbon steel, it is the aim of the writer to treat the subject from the view-point of practical shop operations, and to eliminate theoretical discussion as far as possible. It should be noted, therefore, that no attempt will be made to treat the subject in an exhaustive manner.

It is also assumed that furnaces used for the heat treatment of steel are of the proper design and construction, and that in order to produce the best heating conditions with reference to the character of the furnace atmosphere and control of the temperature, only such fuels are to be used that will give the *right* results for the class of work in hand.

The right results in any heating operation can only be obtained by means of a positive and accurate control of the combustible mixture. Fuels other than gas do not as a rule permit of the close regulation and control of the air-gas mixture that is necessary to control these results.

The human element plays an important rôle in all heat treating processes. Not only is it important to be well acquainted with the chemical composition of steel, the generation and application of heat, but it is also very essential to know the effect of different temperatures, furnace conditions, and methods of cooling upon the constituents of the steel. Absence of such knowledge often results in placing the blame on the steel or the furnace if proper results are not obtained. It is due to this same human element or skill in metal treating that one manufacturer is able to produce a far superior grade of article than his competitor at no greater cost. For this reason he may be justified in guarding such so-called "tricks" with great secrecy.

The skillful application of engineering principles to the design of modern machinery in the last decade has not only brought out the necessity for correct applications in heat treating methods, but has witnessed also the development of special alloys of steel, for particular mechanical purposes. Moreover, the results obtained in heat treating these steels have demonstrated the necessity for greater precision in temperature measurement; consequently the old method of judging temperatures by varying shades of color has given way to more exact pyrometer determinations.

Composition of Steels

Steel is an alloy, a chemical compound of iron and carbon united in varying proportions according to the grade of the steel. It contains about 1 per cent of impurities in the form of manganese, phosphorous, sulphur and silicon. The carbon content varies from about 0.04 of 1 per cent to 2 per cent; the remainder is iron. In addition to the iron, carbon and impurities, some steels contain chromium, tungsten and vanadium, which are added to produce certain results.

Carbon steel is divided into two general classes—low carbon or machinery steel, and high carbon or tool steel. Low carbon steel is soft, ductile and does not harden readily; on the other hand high carbon steel is harder, less ductile and has remarkable hardening power. The strength and utility of steel varies according to the per cent of carbon it contains. The following classification of usage represents good average practice:

Machinery steel contains from 0.04 to 0.15 per cent carbon.

Boiler plate and rivet steel has from 0.15 to 0.38 per cent carbon.

Tires, axles, rails, pistons, from 0.38 to 0.62 per cent carbon.

WE all have a general idea of the importance of heat treatment in the manufacture of steel. Few of us who are not directly connected with this work, however, have any idea of all the things it involves. The very vocabulary of the heat treater—abounding in such strange terms as pearlite, cementite and a host of other -ites, is a thing apart from all other fields of technology. In the article on this page, Mr. Ehlers attempts to give the layman some idea of the nature of the elaborate processes that make the modern high-grade steels what they are.—THE EDITOR.

Cutting tools for soft materials and files from 0.62 to 0.88 per cent carbon.

Heavy cutting tools, bits, chisels and mandrels from 0.88 to 1.5 per cent carbon.

As has previously been stated all steels are an alloy of iron and carbon, the chemical combination of which is of great importance in the study of subsequent heat treating processes. The amount of the carbon content has a very pronounced influence upon the structure of the steel, which when placed under the microscope presents a granular appearance. During the cooling process in the manufacture of steel, the carbon content always combines with a definite amount of the iron, to form what is chemically known as carbide of iron. This combination presents a structure or grain of the metal very noticeable under the microscope and is known as cementite. The remainder of the iron free from carbon is called ferrite. Then again the cementite will form a mechanical mixture with the ferrite, in which the ferrite and cementite will appear in alternate stratas or layers and this is termed pearlite. The relation between these three compounds is such that all steels, very low in carbon, are made up almost entirely of ferrite or iron, with a very small per cent of pearlite. As the carbon content is increased the pearlite increases with a corresponding decrease in ferrite, until the steel has reached 0.85 per cent carbon, when the ferrite will disappear and it will be entirely pearlite. After this point, cementite will appear, and a further increase in carbon will cause an increase in cementite with a corresponding decrease in pearlite. This relation is clearly indicated by the diagram at the bottom of this page. Thus it will be noted that a steel containing 0.6 per cent carbon will be made up of about 67 per cent pearlite and 33 per cent ferrite.

In order that steel may be useful for many mechanical purposes its structure must be changed. In other words, the relation between the ferrite, pearlite and cementite must be different from that found after the steel has cooled in its manufacture. This change is brought about by various methods of heating and cooling. Such changes, while interesting to study, are too complicated perhaps to be described here. It should be remembered, however, that all successful steel treating operations depend upon an appreciation of what takes place in the structure of the alloy under the action of heat and the various cooling methods.

The action of heat upon the pearlite, ferrite or cementite varies according to the percentage of the carbon content, hence according to the relation these substances bear to one another. It causes a transformation of the above constituents, which may easily be seen with the aid of a microscope. The ultimate result, if the steel is heated beyond a certain point, is to form a new constituent known as austenite. Now if the steel is allowed to cool slowly from the temperature at which this new structure appears, it will go back to the original state in which it occurred before heating. In the slow cooling process, however, there are certain characteristics brought out which are worthy of consideration; the transition taking place after the austenite stage is passed, is in the following order: Martensite, Troostite, Osmondite, and Sorbite, each stage denoting a correspondingly softer state of the alloy. This may be likened somewhat to the behavior of water when made to freeze into ice and then melted back into water, the constituents in this case, however, remain the same but appear in a different form, while with the constituents of the steel there is a constant

(*Continued on page 144*)

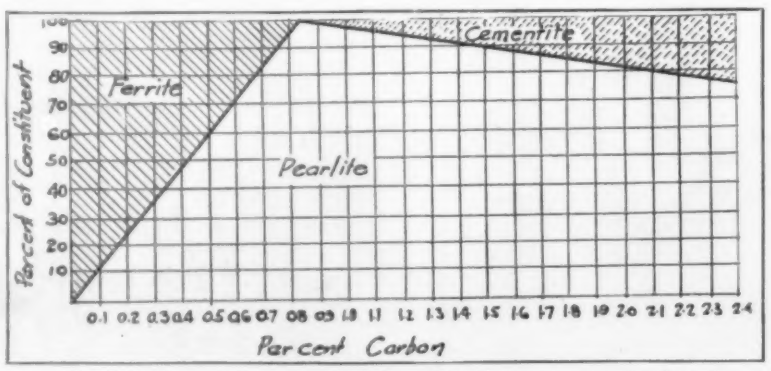


Chart showing relation of percentages of the three components of steel

This furnace serves the combined purposes of heating and cooking

A Combination Heating and Cooking Furnace

A NEW and improved type of combination heating and cooking furnace, which promises to solve the question of economically and efficiently providing hot-water heating for small as well as large houses, has been invented by a Canadian. This new furnace is, undoubtedly, a long step in advance of the ordinary method of heating homes by hot air and is more economical to install than any other type of hot-water furnace. It is intended to be installed in the kitchen, thereby making the usual kitchen stove superfluous.

The accompanying illustration shows the exterior of this new furnace which, it is claimed, will burn any kind of coal or wood. It is constructed with three separate water magazines, each of which may be fixed separately. The regulation of the draught by the small upper door ensures perfect combustion and reduces to an absolute minimum the waste heat which is a feature of the average furnace.

Among the many advantages of the new furnace may be mentioned economy of operation, one ton of coal in three being saved by the elimination of the kitchen stove. The domestic cooking can be done on it and a splendid supply of hot water may be obtained at all times, there being two systems in the furnace, one for domestic use and the other a circulating system for heating. Other important points are the saving of physical energy by having only one fire to attend to instead of two, and that one in the kitchen; the proper regulation of heat throughout the entire house by means of the radiators; and the total elimination of the danger of fire which is ever present with hot-air heating.

The basement, with the usual furnace installed there, becomes much too hot to be of use as a cold storage, but with the removal of the furnace with its consequent ashes and dirt the basement will be both clean and cool enough to be used for storage of vegetables, preserves, etc., thereby practically adding another room to the house.

As is well known, the amount of air required to consume a pound of coal will occupy a space of one hundred and twenty square feet, so it is readily seen how the installation of the furnace in the kitchen ensures a perfect system of ventilation which must be beneficial to the housewife who spends so much of her time there.—*Robt. Veitch.*

Automatic Regulator for the Heating Plant

IN these days of shortage and high values of coal and other fuels there is bound to be more than ordinary interest in a means for not only economizing in the amount of fuel consumed in running houses or the like, but also in the effective manner in which a desired degree of temperature may be established and maintained. Messrs. H. W. and R. H. Souder of Tamaqua, Pa., have devised and put into practical and extensive operation a little machine which might be termed "A Watch Dog of the Coal Pile." However, this machine does vastly more than to watch the coal pile or the furnace which consumes the coal, because it automatically insures a predetermined degree of heat for the living rooms either night or day.

Briefly set forth, the machine consists of mechanical connections with the draft-controlling means of a furnace or the like, the source of power being a small electric motor adapted for the use of either direct or alternating current from the ordinary house supply through a plug and cord. At any desired place in a living room is located a thermostatic device comprising two thermostats, one for day use and one for night use. Assuming, for example, that the temperature for the day is desired to be maintained at 70 degrees, the day thermostat will be adjusted to such point; and if the night temperature is desired to be at 50, the night thermostat will be adjusted accordingly. Associated with the motor for controlling the drafts is a clock mechanism having day and night commutators for the day and night thermostats respectively and in circuit therewith. Said commutators are adjusted so that the machine will automatically shift from the day thermostat to the night thermostat at a predetermined hour and likewise in the morning it will shift automatically from the night service to the day service. More specifically, if the rooms are desired to be kept heated until retiring time at say ten o'clock and the nature of the heating apparatus is such that it requires an hour to cool down from the day temperature to the night temperature, the night commutator will be so adjusted as to become effective at say nine o'clock, at

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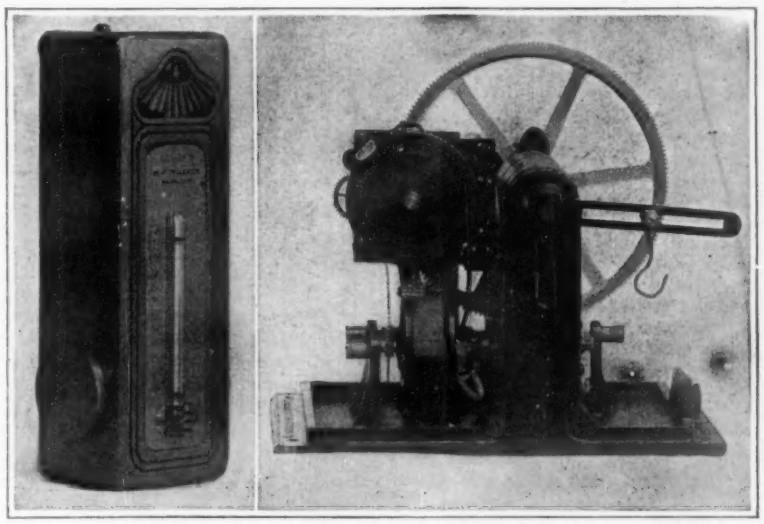
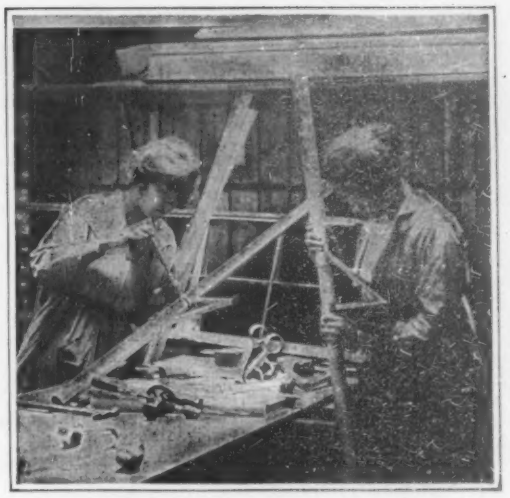


Thermostatic regulator and the mechanism which controls the operation of the heating plant



Converting airplane struts into stilts—an instance of industrial reconstruction

From Airplanes to Toys

WE hear much about reconstruction in Europe—of how the late belligernts ar converting their wartime plants into peacetime establishments. But just what that means is only made clear by an occasional concrete example instead of meaningless generalities.

Here, for instance, is a case in point. The women workers shown in the accompanying illustration are in the employ of a leading British aircraft manufacturer who has turned from the building of airplanes to the manufacture of toys. Thousands of airplane parts left over as a result of cancelled war contracts are now being converted into toys of various kinds. In the accompanying illustration the women workers are making stilts from airplane struts.

Generating Electricity at the Mines

FOR years engineers have advocated generating electricity at the mines and transmitting the power over long distances to cities and industrial centers. Obviously, such a method, on the face of it, is more economical than transporting coal to distant power plants; but in most instances the distances between mines and consumers have proved too great for practical electrical transmission, and so the scheme has been left for a later day when current can be transmitted over great distances with less loss.

It has remained for the Germans, however, to put such a plan into practical operation. During the war, under the heavy ban of secrecy, the long-cherished plan of the late Emil Rathenau—the German Edison and father of Dr. Walther Rathenau, head of the great electrical company of Germany—to supply Berlin with light and power by means of a power plant located in the heart of the brown (lignite) coal country, was put into effect. In the village of Aschornewitz-Golpa, near Bitterfeld, in Prussian Saxony, 75 miles southwest of Berlin, there was erected a generating plant capable of developing 128,000 kilowatts of electricity, or more than twice as much as is needed by the German capital. That was in the fall of 1918. Of late Berlin has been receiving 30,000 kilowatts from the distant power plant, but as soon as the necessary additions are made in the transmission system the output will be increased to somewhere near the plant's capacity.

Coal for the 64 boilers of this power plant, which have an aggregate heating surface of 8,000

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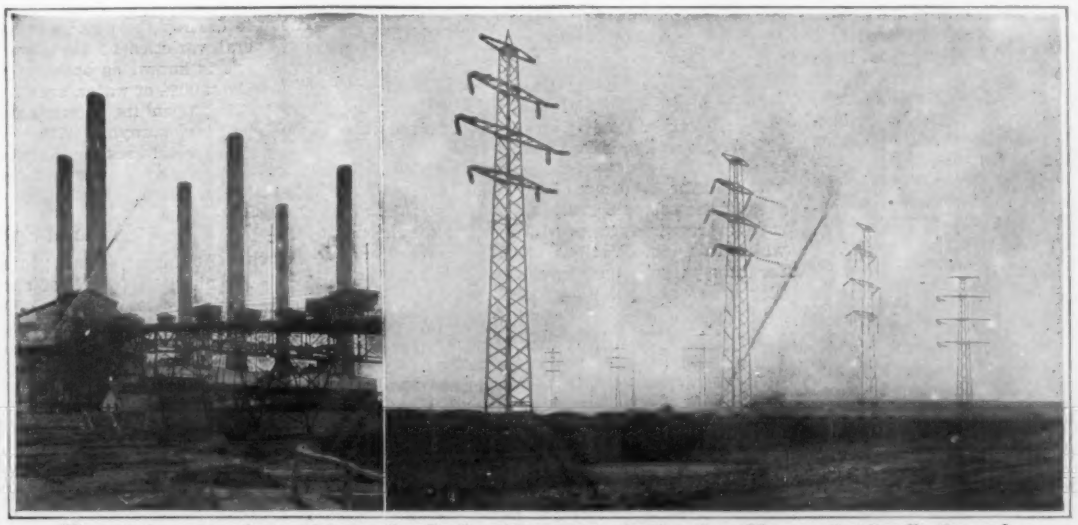


View of the power plant which supplies Berlin with current, showing the cable cars that handle the coal, as well as the long-distance transmission line

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Tax Free Alcohol for Chemical Laboratories

THE importance of pure alcohol in chemical industry and in investigative work has already been impressed upon our readers. It is encouraging that the United States Department of Internal Revenue has recently announced that a special denatured alcohol may be used in chemical and physical laboratories which must first secure a permit. The formula which has been authorized provides that to each 100 gallons of pure 95% ethyl or grain alcohol there is to be added 10 gallons of pure methyl or wood alcohol having a specific gravity of not more than 0.810 at 60° F.

The growing use of a new motor fuel a large percentage of which is alcohol again emphasizes its economic importance. Such fuel costs more than gasoline but its users claim an increase in mileage which makes it economical, besides a freedom from carbon in cylinders and in spark plugs that saves real money. A start has been made to assist research and development work. May we not soon have some of the restrictions removed which now burden the chemical manufacturer, placing him at a disadvantage, in comparison with some foreign competitors?

Geology and Bacteriology

THERE are many instances where the most illuminating advances have occurred when various branches of science have adopted each other's methods in special cases or have called in a sister science on some problem. Since physical chemistry became established as a new field for scientific effort, we have made progress vital to much of our industrial as well as academic work on problems which in many instances resisted the attack made with our previous information. Geophysics is another striking example, while medicine often calls in another science to advantage.

Geologists are realizing more fully as they extend their studies the magnitude of the work done by plants and animals in building up and tearing down parts of the crust of the earth. Even microscopic organisms perform a large part of this work. Pasteur long ago showed us the deadly power of bacteria in disease and their efficiency in promoting germination, but their influence on the fertility of soils and their work in expediting rock decay are still subjects of scientific study.

Bacteria evidently not only aid in the decomposition of rocks and in the formation of beds of chalk and limestone, as has recently been demonstrated, but are active agents in the deposition of some beds of iron ore. Engineers have learned that iron-depositing bacteria may be troublesome pests through their ability to clog the pipes of city water-supply systems with hard, thick crusts and slimy, rusty masses composed of millions of individual bacteria. E. C. Harder of the United States Geological Survey, who has examined deposits of iron ore in many countries for the special purpose of determining their mode of origin, has recently made close studies of the action of bacteria in forming iron ores. He has found the so-called "iron bacteria" actively engaged in the deposition of compounds of iron not only in surface iron-bearing waters but in mine waters to depths of several hundred feet and has made laboratory cultures of various iron-depositing bacteria.

Mr. Harder describes the iron-depositing bacteria, gives the results of his laboratory experiments in bacterial iron deposition, considers the probable extent of the influence of bacterial action in forming deposits of iron ore, and gives a bibliography containing the titles of many papers on the work of bacteria in rock and ore deposition.

An Effort to Cheapen Rubber

FROM Great Britain comes the report that S. C. Davidson, after eight years of research, has demonstrated on a laboratory scale a process which, if as successful on a commercial scale, may revolutionize methods of rubber manufacture.

Under the present system the latex has to be converted into rubber within twenty-four hours from the time it is extracted from the trees to prevent putrefaction, but when treated by Davidson's process it is said it can be kept for any length of time. The latex used in the demonstration was more than a year and a half old and was stated to be in every respect in as perfect condition for manufacturing purposes as on the day it was collected on the plantation.

With the methods now in operation on a plantation it takes at least a fortnight to bring raw rubber into condition suitable for transmission to the market, but with Davidson's process under operation within thirty minutes a milk-like liquid had become a high quality rubber ready for the market.

Water-proofing Textiles

THE demand for water-proof fabrics was greatly increased during the war and many a manufacturer found it desirable to learn at once how to water-proof goods that would not only meet the approval of customers but the Government inspectors. All textile fabrics cannot be successfully water-proofed by any single process, for each of them requires treatment depending upon the service expected of it. There are two general classes of water-proofing which, according to Dr. Matos, can be designated—first, where the pores of the fabric are completely closed and the individual threads cemented together by a water-proof substance such as a rubber composition, and second, fabrics where the pores are not closed but where the individual fibers are made water-proof or water repelling.

All water-proofed fabrics will not withstand heavy downpours of rain. For example, a tarpaulin is made and treated in a manner that will enable it to shed the heaviest rains, whereas a fabric such as an overcoating material which has been treated cannot be expected, nor is it intended, to repel hard storms.

Some methods employ chemical salts which deposit an insoluble material in and on the threads, and others consist in treating the material with a solution of wax or rubber. An example of the use of chemical salts is the so-called "soap process." In this 200 pounds of aluminum sulfate are dissolved in 80 gallons of hot water and separately an equal amount of lead acetate in 60 gallons of water. These two solutions are then mixed slowly with constant stirring and after allowing them to settle, the clear liquor is drawn off and water added until a gravity of 9° Tw. is obtained. After the cloth has been well pregnated with this liquid, it is passed through the soap solution, made by dissolving from one-half to three-quarters of a pound of hard white tallow soap per gallon of water. A deposit of stearate of aluminum is formed on the cloth and as this cannot be removed by washing, it renders the fiber water repellant. The treatment is often repeated in order to obtain the best results.

A process which answers nearly as well for cotton or woolen consists in depositing the basic acetate of aluminum upon the cloth by slowly drying a solution obtained by the reaction of aluminum sulfate with lead acetate. After slowly drying, the cloth is steamed and the basic acetate of aluminum is then fixed by subjecting it to the action of dry heat. Various formulæ have been devised for different grades of fabric.

Water-proofing with waxes, such as paraffin, stearic acid, ceresine, and the like, is accomplished by dissolving the water-proofing material in some such convenient solvent as benzene, passing the goods through the solution and calendering it after the cloth has dried. The result is a fabric that has been impregnated without having the pores closed. Excellent results have been obtained by employing mixtures of paraffin wax and rubber, which are first mixed hot, and upon solidification, are cut in small pieces and dissolved in benzene or gasoline. The resulting composition on the goods is admirable—water-resisting and odorless. Working with volatile solutions of this sort involves some danger, as the solvents are highly inflammable, and great care is required in providing safe conditions under which to work. Various machines have been devised for this purpose and special ventilating systems employed.

Vanadium in Steel

IN a paper read before the American Society for Testing Materials, Mr. G. L. Norris discussed the effect of vanadium upon steel alloys, and stated that until vanadium is present to the extent of 1 per cent, the physical and mechanical properties of steel increase as the percentage of vanadium is increased, but when 1% is exceeded and with 3% or more of vanadium, the steel is actually softened on quenching until unusually high temperatures are reached. As much as 3½% of vanadium has been successfully used in high speed steels and 1.5 to 2.5% is not uncommon. The improvement in high speed steel through the use of vanadium bears an almost direct relation to the percentage of the element present.

In the case of carbon-vanadium steel, the use of vanadium has proven almost equally beneficial. Such steel hardens deeper, retains its cutting edge much better, and is both tougher and stronger than steel without it. For comparison, it may be stated that a bar of 1 per cent carbon tool steel containing one quarter of one per cent of vanadium, quenched and drawn back at 400° C., may be bent ninety degrees without failure, whereas a similar bar without vanadium will fail when bent through twenty to thirty degrees. Compression tests on 1¼-inch cubes gave 470,000 pounds for the vanadium alloy and 278,000 pounds for steel without that element.

Vanadium steel therefore appears to combine hardness, strength, and toughness, which makes it admirable for pneumatic tools, rock drillers, and the like. The greater ease of machining vanadium steel as compared with carbon steels has made them particularly useful in the construction of automobile parts, where labor constitutes a large item and some parts can be made of vanadium steel at less than one-half the cost of the same part from high carbon steel.

Hydroelectric and Electrochemical Development

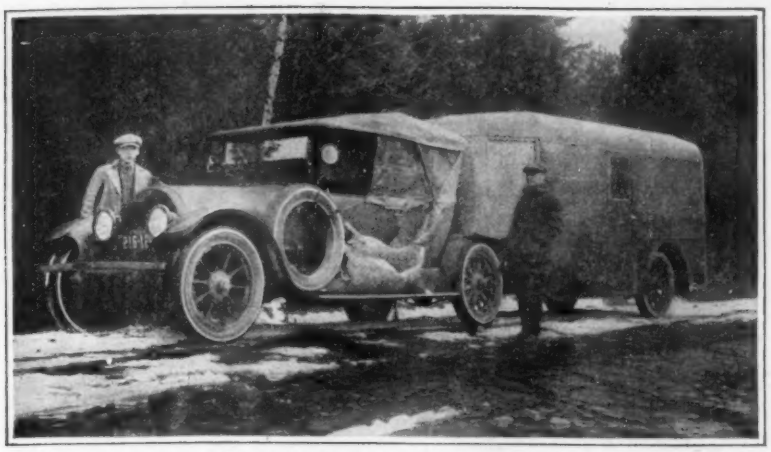
THE dependence of certain countries upon imported coal has caused unusual activity in the harnessing of water power and since the war, France as a war measure is reported to have developed some six milliin hydroelectric horse-power, equivalent to twenty million tons of coal annually. In Italy hydroelectric power developed and economically used enabled her to engage in war activities in 1917 on something less than one-half the quantity of coal imported in 1913. In Switzerland water power has become the great industrial hope of the nation and while immediately preceding the war, there was considerable development along these lines, the work necessarily was held in abeyance during the time when the importation of copper wire and other raw materials for electrical machinery could not be freely carried on. At the present time, however, this work is being energetically pushed and there is promise that within a few years the Swiss will be largely freed from their present dependence upon imported coal supplies for industrial purposes. No doubt coal for domestic purposes and heating will continue to be imported, but in Switzerland as elsewhere a great deal of hydroelectric power can be used and made the basis of new industries.

An Opportunity for Scientists

THE states of Queensland and New South Wales are confronted with a serious difficulty due to the rapid spreading of the prickly pear over millions of acres of land, to which thousands of acres are being added yearly. It is generally supposed that birds and water courses are responsible for this rapid spread and the many methods that have been tried in an endeavor to destroy the pest have so far failed. There are several varieties of the pear growing, but the principal one is known as *opuntia incinus* and since it contains about 90% of water, even drouth conditions have had no effect upon its extermination. Cutting, rolling down, burning, spraying with poisons, and attempts to find commercial uses for the prickly pear have been unavailing and it appears therefore to be a real problem for the scientist.

Value of Sprouted Grains

FOR hundreds of years the Chinese have recognized the worth of sprouted grains and seeds and employ them in many of their dishes, adding a portion of meat to give flavor. Thus the well-known chop suey contains sprouts of rice or beans and furnishes a far better food than is commonly believed, providing it is not drowned in Oriental sauces. The value of this food lies in the fact that sprouting, just as in the case of malted barley, makes the starch more digestible and easily assimilated by children and invalids. Sprouted grains, beans, and peas develop the necessary vitamines and can be made to serve as satisfactory substitutes for many of the expensive fruits and vegetables.



The motor bungalow on the road

Motor bungalow set up on the road for campers

The Motor Bungalow

THAT the fineness of design and workmanship required in aeronautical construction may be profitably applied to everyday uses, is suggested by the camp car illustrated on this page. This is a motor bungalow which Glenn H. Curtiss, the well-known pioneer aviator, inventor, and builder of the NC-4 flying boat, and the world's altitude record holder, the "Curtiss Wasp," has designed. It is characteristic of the inventor, that when a need arises, he instinctively fills it with a construction of his own. A new invention is the result.

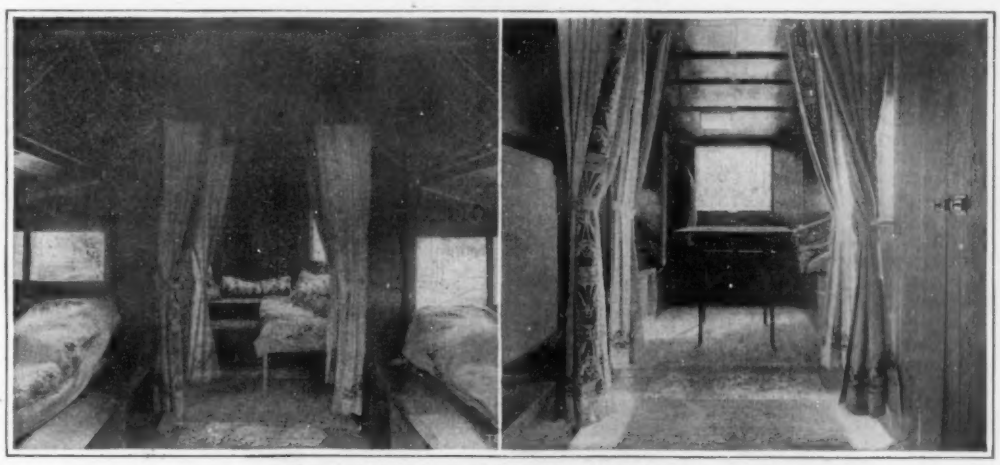
The idea back of the Curtiss camp car is that of a compact hotel on wheels which the lover of outdoors can attach to his automobile and carry with him wherever he goes. This miniature Biltmore is easily hitched to an automobile and can be whisked along at a speed of fifty to sixty miles an hour without the owner being conscious of his added burden.

The "motor bungalow," as one of his friends calls it, is a compact vehicle with windows front and rear, doors on either side, strongly but lightly constructed of wood veneer. It is comfortable and weather-proof and even in inclement weather, furnishes a traveling home which is bound to be the envy of even the most comfort-loving gypsy. It has a kitchen, pantry, toilet facilities, an ice-box, clothes and bedding lockers, electric lights, a running water system, seats, a table, and even carries a tent cot for use of the chauffeur.

Its really useful characteristics, however, become apparent when it is opened for camp service. By raising the sides and inserting screen frames, the vehicle may be made up into two complete rooms with ample sleeping facilities for two people in the fore end, and four people in the after end. The rooms are divided by curtains and there is plenty of space during inclement weather for serving meals on a table in the after compartment, the berths on both sides serving as seats, and a compact folding table playing the rôle of the festive board. The full screen equipment gives protection from flies, mosquitoes, and other insects, and a full complement of water-proof curtains is provided which may be drawn down as a protection against rain or the cool of the evening.

The car is a veritable efficiency apartment on wheels. So effectively and completely has Mr. Curtiss worked out the details and equipment that by opening a door at the rear, all of the necessary utensils and tools, such as spade, axe, etc., for setting up camp will be found instantly available. A locker on the port side forward carries the camp stove and kitchen outfit so that no matter if it is raining and the wood is wet, some steaming soup and a good hot cup of coffe can be had in a jiffy by the itinerant campers.

And the proof that this hotel on wheels can give service has been amply rendered by several trips which Mr. Curtiss and his associates have taken through the Adirondacks, Berkshires, and Catskills, amounting to over a thousand miles.



Two interior views of the motor bungalow

Collapsible Wings for Airplanes—Why Not?

THERE is no doubt that the bird is a better machine than any that man has made for the purpose of flying, at least so far. The moment a bird lands its wings are contracted, thereby enabling the bird to settle quietly on land or sea. It would be impossible for the bird to shoot straight down and alight on the chosen spot, were it compelled to do so with its wings fully extended. Yet it is for that very reason that our powerful flying machines so often meet with accidents when landing. In addition to this, the present ever-rigid wing causes great inconvenience in connection with the housing problem and makes transportation very difficult.

If a gull should attempt to remain floating with wings stretched out on the sea, it would soon lose its balance and share the fate of the hydroplanes which in the recent attempt to cross the ocean had their wings badly battered when compelled to descend and alight on the rough sea.

We know that wings swinging back on hinges will reduce the original span of the plane to some extent, and partially solve this problem. It has remained for someone to design a practical and properly constructed contractable wing for present-day types of airplanes.

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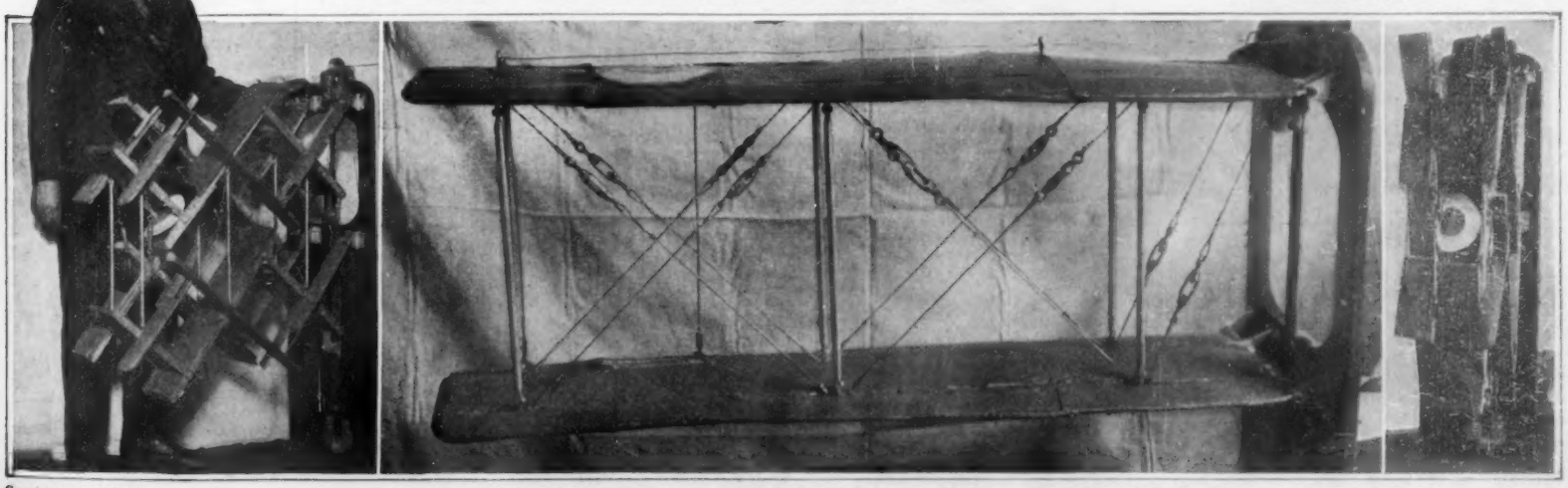

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Left: The wings partly extended, showing the lazy tongs arrangement by means of which they are folded. *Center:* The plane with wings extended for flight. *Right:* The wings folded for packing.

The airplane with collapsing wings that can be stored in a small space

Inventions New and Interesting

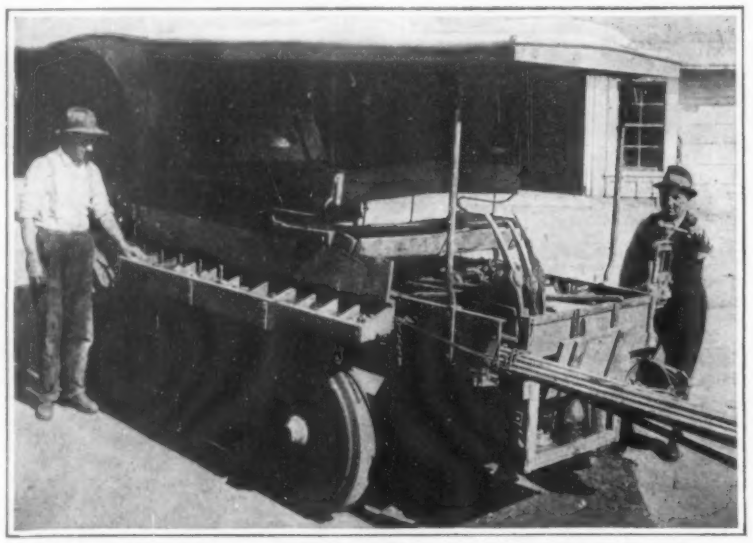
A Department Devoted to Pioneer Work in the Arts

The Handy-Man's Motor Truck

MANY auto trucks which are operated by the Water Department of the city of Los Angeles are equipped with bodies of special design, as shown in the accompanying photograph. These particular trucks are designed so that it is not necessary to carry the long pipes on the side of the body, but they are carried in one side of the truck body. The end-gate is cut off about eight inches from one side of the body allowing the long pipes to project. A piece of angle iron is bolted to the bed at the point where the end gate is cut off. An old gasoline tank has been mounted under the back part of the bed, and is used for carrying the lunches of the workmen. This keeps the lunches safe and clean. On the left side near the back, on this same truck is a box which carries pipe joints, and "T's." Just back of the seat and extending across the bed is a special box for carrying jacks, water pump and valves. To the left of this there are two special hooks for carrying a hose and under the body of the truck is attached a box which carries instruments used in the work, keeping them free from jar and breakage.

A special box is built in on the left side of the truck, and divided off into compartments, in which are carried unions, couplings, elbows, etc. On the rear of this truck there has been fastened a pipe vise. By means of this pipes can be easily threaded, all pipe cutting and threading equipment being also carried in a special compartment on the truck. A box has been fastened under the back of the truck, in which are carried lanterns, which are left at excavations at night to act as danger signals. By means of a specially designed rod and chain, the pipes carried on this truck are held tightly together at the end gate. In the bottom of the bed near the end gate there are provided sockets, into which the picks are inserted, and held securely.

For use on the trucks carrying long pipes, a device for carrying the danger signal has been designed which can be fastened to the end of a pipe of almost any size. The danger sign is attached to a hook, which is fastened into a union. A hole is then drilled through the collar and a nail is put through. This is then fastened to a two-inch nipple, which in turn is screwed into a coupling, which in turn is screwed on to the end of one of the pipes on the truck. If the pipes carried on the truck are ¾ inch or 1 inch in size, then this size bushing is screwed into the coupling.—*C. W. Geiger.*

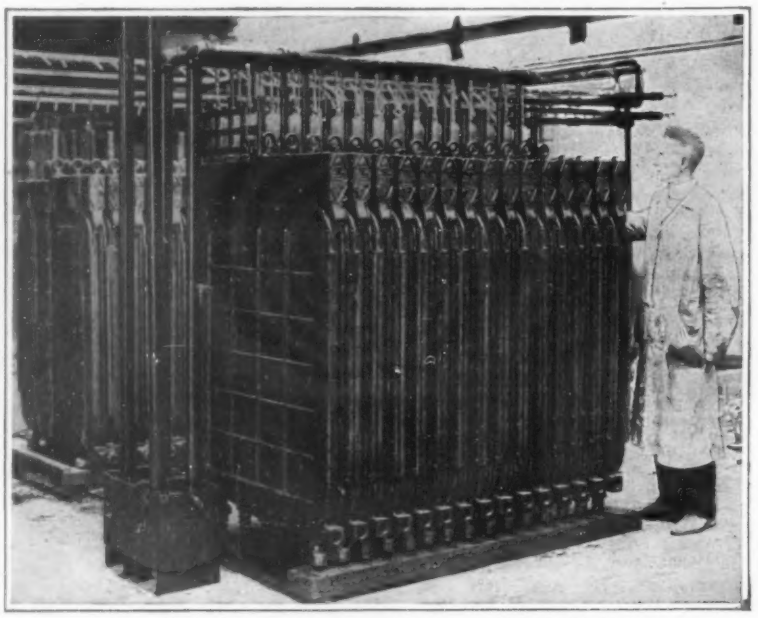


A truck arranged for carrying pipes and water-department supplies with greatest convenience

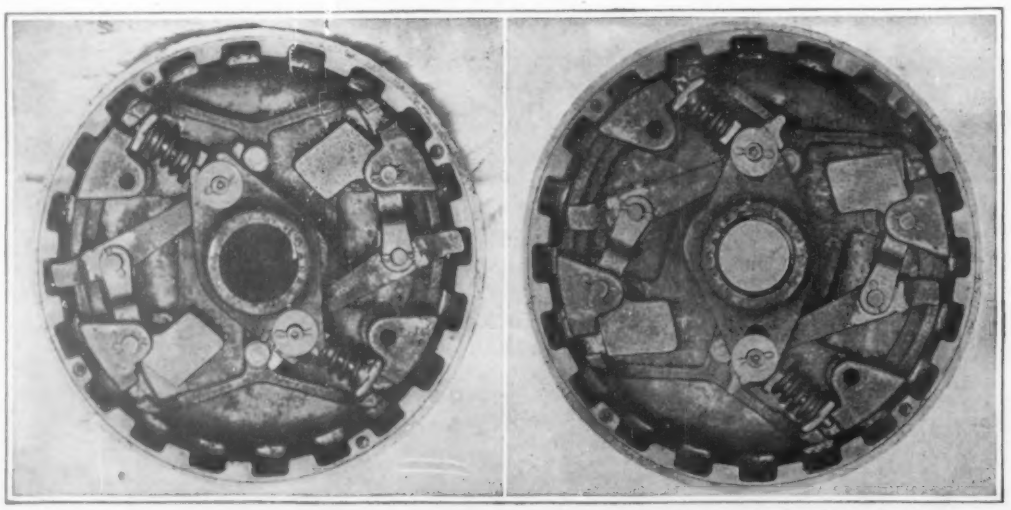
A New Type of Overload Release

A DEVICE which will automatically disengage the driving from driven machinery if the load exceeds the predetermined amount has recently been introduced by a Chicago manufacturer. By disengaging the driving gear, this allows the driving motor or any other source of power to run free and prevents damage to the machine to be operated. Regardless of whether the load is gradually or suddenly applied the device will release without any trip from jars or shocks. It can be assembled to operate in either direction as the device is symmetrical. Adjustable for tension the release will operate for any overload.

A spider keyed to the shaft has triggers pivotally mounted on its links, with the ends engaging inside notches in the rim of the drum and rollers. The springs regulated to any desired pressure by adjusting nuts hold the ends of the triggers on the rollers. But when the drive is overstressed the compression of the springs will permit the ends of the triggers to drop into the position shown at the right section, releasing connection with the rim and allowing the driven machine to stop immediately. The collar is provided with fingers that engage the pins on the lower ends of triggers so that the triggers may be set again in the driving position. By turning this collar with a wrench the triggers are moved to the original position and at the same time the outer ends enter notches in the drum. This renews the transmission connection. A cover fits the end of the drum and protects the mechanism. The hub of the drum may be extended to receive a wheel or gear and have a bushing for running loose on the shaft.—*Allen P. Child.*



Single-cell electrolytic generator of oxygen, which yields hydrogen also as an incidental



The new overload release, showing (left) the drive in mesh, and (right) the position which the triggers take in releasing the driven mechanism

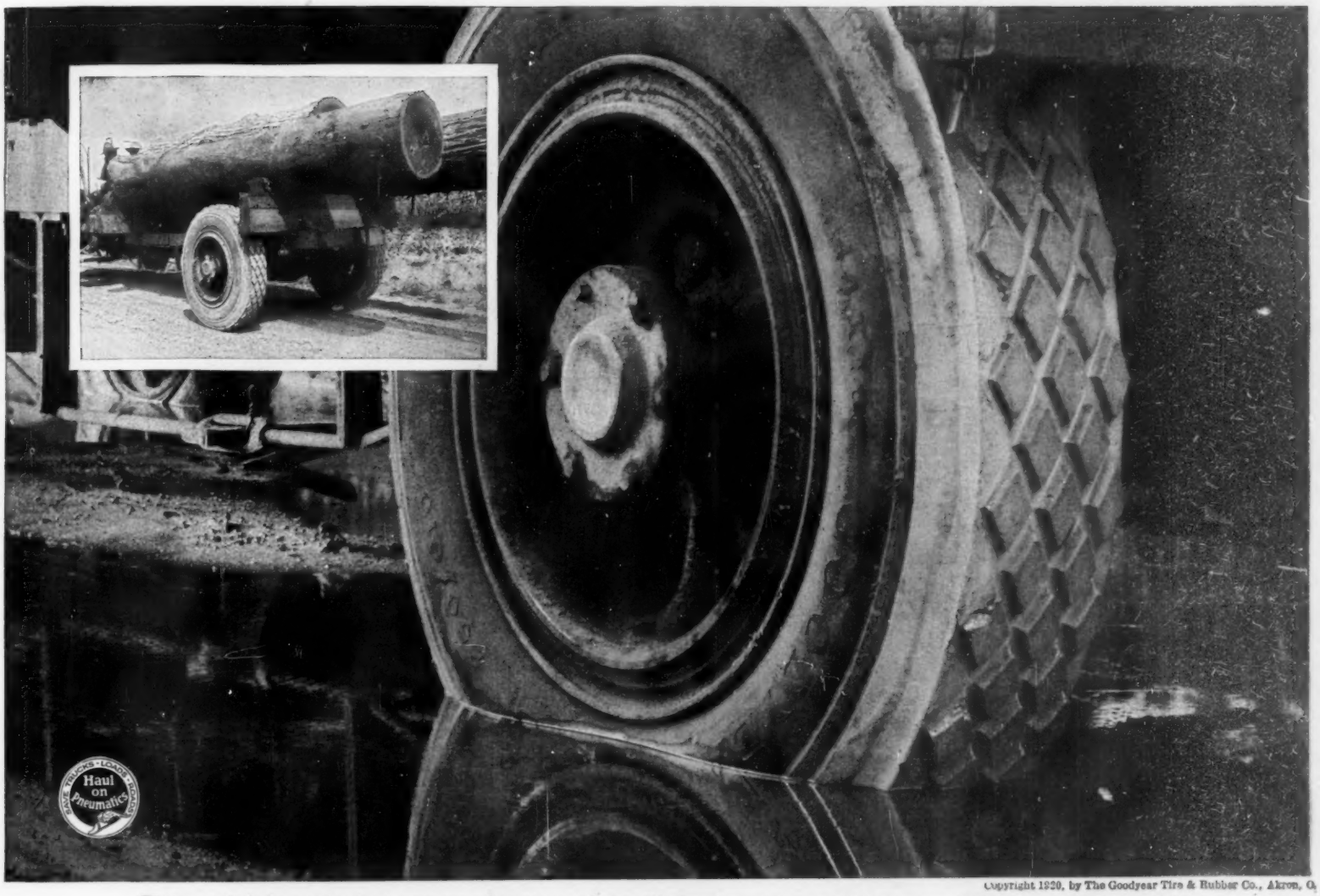
Unit Oxygen-Hydrogen Generator

OXYGEN is used in vast quantities in the industrial world for cutting and welding metals, in connection with hydrogen or with acetylene. In chemical and related industries it finds application in numerous processes of high commercial importance. Hydrogen finds increasing use for oxy-hydrogen cutting and welding. Another vast field is the hydrogenation or hardening of oils, fats and greases. Large quantities of hydrogen are used in aeronautic work, for balloon inflation. And in chemical and metallurgical industries it is used for lead burning, rare metal reduction, and important chemical and synthetic processes.

The highest efficiency in the application of oxygen and hydrogen gases, the greatest speed in operations using these gases, and absolute uniformity in results, demand a supply of gases of utmost purity and at the lowest cost. The photograph shows an improved electrolytic generator of unit or single cell type which, by its performance, has set a new standard of economy in oxy-hydrogen production. While radically new in mechanical design, it embodies no new principles and is in no sense experimental.

The term "unit" as applied to this generator, means that each generator is self-contained or complete in itself, capable of generating pure oxygen and pure hydrogen at a rate determined by the amperage of the electric current supplied. Each of these units requires a floor space of 4 x 40 inches, or about the equivalent of a square foot; and with necessary pipe connections, needs head-room or height of about 6 feet. With this unit as a basis, expansion of plant and increase of capacity become simply a matter of adding units as needed to give the generating ca-

(Continued on page 151)



Copyright 1920, by The Goodyear Tire & Rubber Co., Akron, O.

IN explaining why he is arranging to replace all the remaining solid tires on his motor trucks with pneumatics, Mr. Henry Fowler, Treasurer of the Case-Fowler Lumber Co., Macon, Ga., writes: "Our trucks on Goodyear Cord Tires carry capacity loads of logs through mud and sand usually impassable to our solid-tired trucks. Indeed, the trucks on the Goodyear Cords frequently have pulled the solid-tired trucks out of mire and sand in which they have become stuck. Your pneumatics not only reduce fuel consumption and upkeep generally while increasing our daily trips, but they are particularly fitted for our rough work by reason of their downright toughness."

WHILE the business man quoted above and many others have been demonstrating the advantages of the perfected pneumatic truck tire, Goodyear has developed proof of an extraordinary nature.

Since April 9, 1917, the Akron-to-Boston Express has been running night and day, carrying Goodyear freight on pneumatic tires over its 1,500-mile highway circuit.

More recently the Akron-to-Cleveland Freight Line and the Goodyear Heights Busses have been adding to the evidence of cord pneumatic efficiency for all-year transport.

These extensive undertakings have sprung from the belief of Goodyear engineers in the eventual widespread adoption of pneumatics to free motor trucks of solid-tire handicaps.

They have followed the original development of the Goodyear Cord construction, begun several years ago, on which the whole practicability and every virtue of pneumatic truck tires is based.

They have been the means of exhaustive tests of Goodyear Cord Tires for trucks, also Tubes, Rims, Repair Materials, and others' engine pumps and air gauges made in collaboration with Goodyear engineers.

Now the cost data, developed by these pioneer fleets of pneumatic-shod highway trucks and busses, can be obtained by writing to The Goodyear Tire & Rubber Company, at Akron, Ohio.

GOODYEAR
CORD TIRES

Spicer

UNIVERSAL JOINTS AND PROPELLER SHAFTS

IN great oil-fired heat-treating furnaces the working parts of SPICER UNIVERSAL JOINTS and PROPELLER SHAFTS take on strength for the heaviest service—service which only the finest steel can endure.

The accuracy with which SPICER heat-treating processes are controlled is one of the reasons why SPICER UNIVERSAL JOINTS and PROPELLER SHAFTS have, since 1904, consistently out-lasted the finest cars.

Today over one hundred of the leading makes of automobiles and trucks are SPICER equipped.

Genuine SPICER UNIVERSAL JOINTS bear the SPICER name on the flange.

SPICER MFG. CORPORATION
SOUTH PLAINFIELD, N. J.

The Heat Treating: Number Seventeen of a series of SPICER advertisements.

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Spicer Propeller Shaft

February Issue of the Scientific American Monthly

(*Continued from page 127*)

propel a rocket beyond the influence of the earth. The interesting experiments performed by Dr. Goddard are described at considerable length in the current issue of the SCIENTIFIC AMERICAN MONTHLY. In this issue there is also a popular exposition of Einstein's relativity theory of gravitation.

Aviators are very much bothered, particularly in summer time, by what they call "bumpiness" of the air. In other words, there seem to be upward and downward local currents that make their machines plunge and careen and which are a serious menace to flying, particularly near the ground. The cause of these currents, and a discussion of the places where they are most likely to occur is described at considerable length. In this issue will also be found an interesting discussion of the destructive range of depth bombs, and also of their use to determine the position of a vessel in a fog. It is not generally known that the British used this method of guiding their monitors through the fogs of the English Channel and the North Sea. The period of time required for sound to travel from the depth bomb to two or more stations gave an accurate measure of the distance of the bomb from these stations, and the position thus determined was then sent by wireless telegraph to a vessel.

"Spiders as Mechanics" is the title of a very interesting article which describes the skill of these little creatures in weaving their webs, excavating underground dwellings, erecting masonry walls around such dwellings, and also constructing kites by which they can fly from one region to another.

These are but a few of the interesting articles to appear in the February issue. There will be the regular departments containing abstracts of literature in the fields of mechanical, electrical, mining and chemical engineering, also the department of the National Research Council and the Bureau of Standards.

The Panama Terminals

(*Continued from page 131*)

run-of-the-bank gravel. It was expected that this mixture would produce a concrete having a compressive resistance of 2,000 pounds per square inch, when the concrete was 28 days' old. Upon test, this expectation was not fulfilled. However, after experimentation, it was found that if a certain relative amount of a very fine sand that was in the gravel were removed and if the gravel were washed, the resulting concrete would be nearly 100 per cent as strong again. It was found, in fact, that by washing the run-of-the-bank gravel over a wire screen having a 1/16-inch mesh and set at an angle of 45°, the right amount of fine sand was eliminated in addition to the general cleansing effect.

The shed was, as originally designed, to have a steel frame. The weight of structural steel required was estimated at 4,400,000 pounds. When the bids were opened in the spring of 1918, the cost of a steel structure was found to be 150 per cent greater than for the corresponding material on Pier 7. So, reinforced concrete was again called in to relieve the situation. Since then, the structure has been pushed to completion. One of the views gives a very good idea of the pillars, roof trusses and roof of Pier 6.

Pier 7, the next pier to the east, jutting out from Cristobal Mole, is, as has already been indicated, a somewhat different structure. Both great piers have foundations of steel shells filled with concrete. And both have superstructures of about the same dimensions. The remaining large features, or the most of them, differ greatly. Pier 7 has a steel floor system and a steel framework, while the corresponding features of Pier 6 are of reinforced concrete. The roof of Pier 7 consists of a cement tile that was made on the Isthmus by a private company doing government work. The doorways of Pier 7 are more commodious than those of Pier 6, as the reduction of such openings was one of the devices adopted to cut down cost. It will readily be understood, perhaps, that the construction and installation of the doors for such a big structure as Pier 7 would be a considerable undertaking. There are 80 large steel doors. These are placed on the pier sides, two doors to each 45-foot opening. These doors are divided by a swinging column. At the ends of the pier, smaller doors of the same general type are installed. While the frame of Pier 7 is of structural steel—2,205 short tons of it—the walls and columns are of concrete. Altogether, some 2,347 cubic yards of concrete were poured into the forms for these features. The mode of construction of the walls, particularly above the 10-foot level, will be of interest. Solid concrete, reinforced and 13 inches thick, was employed for the first 10 feet from the floor up. Above this level, interlocking corrugated steel plates were set in place and then plastered on both faces with Portland cement plaster containing a minimum of lime, to increase the durability of the material and the protection to the reinforcement.

Coöperation and Industrial Progress

(*Continued from page 132*)

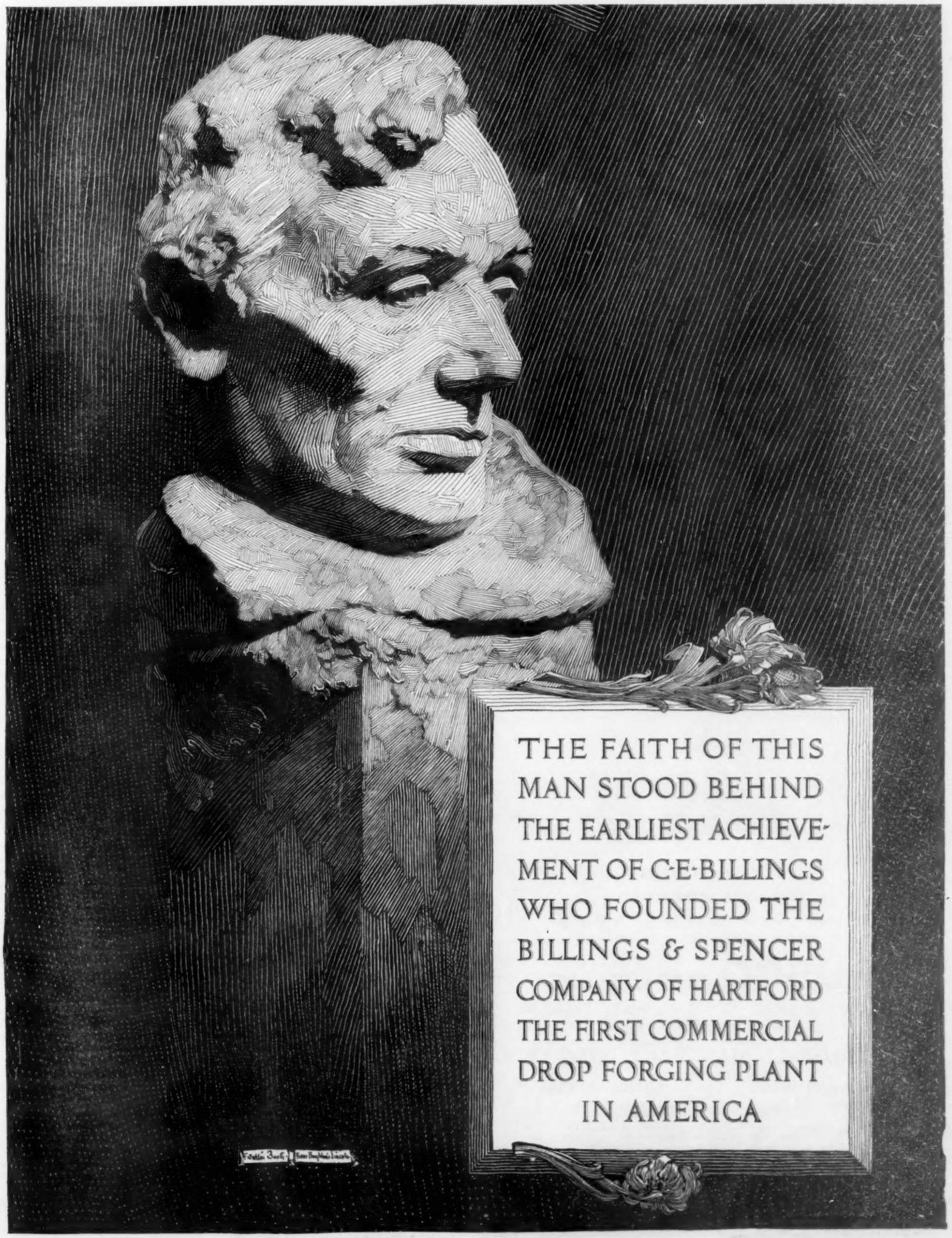
where representatives of the management and the employees will deliberate upon its merits. If they are unable to settle the affair it should go to the president of the company. If the president cannot accept or suggest a satisfactory adjustment, there comes the question of arbitration. Perhaps here, future developments will assign the duty of arbitrator to representatives of the community, but at present such agencies do not exist. In general if there has been a sincere endeavor on the part of all concerned to examine the question fairly and frankly, there will be small need of arbitration.

Any plan of employee representation will fail unless there is a real determination to avoid any discrimination (and here again I quote from our plan) "on account of race, sex, political or religious affiliation, or membership in any labor or other organization." This does not mean, for example, that an employer forfeits the right to employ whomsoever he wishes. It does mean that once a man wishes it does mean that once a man has been considered worthy of employment he has now entered into the bosom of the industrial family and must be considered worthy also to express his own opinions upon matters affecting himself.

If employee representation is to succeed it must have executive supervision, just as industrial concerns employ specialists in machining, in foundry work, in heat treating, in progressive assembly, in accounting and the like. And as they recently found it desirable to employ specialists in employment and safety work, so now they are finding it necessary to employ specialists in industrial relations. The best man in the country is not too good to act as chief of the department of industrial relations of any company incorporating such a plan. The man chosen may be related either to the president of the company or to the official in charge of production. The labor problem is the great question of today and tomorrow, and the specialist who gives his attention to its solution cannot be too well thought of in any industrial organization.

This paper has advisedly been given the title, "Coöperation and Industrial Progress." Coöperation means that those employers who have adopted employee representation are finding a practical application of the theory that Capital and

(*Continued on page 144*)


THE FAITH OF THIS
MAN STOOD BEHIND
THE EARLIEST ACHIEVE-
MENT OF C-E-BILLINGS
WHO FOUNDED THE
BILLINGS & SPENCER
COMPANY OF HARTFORD
THE FIRST COMMERCIAL
DROP FORGING PLANT
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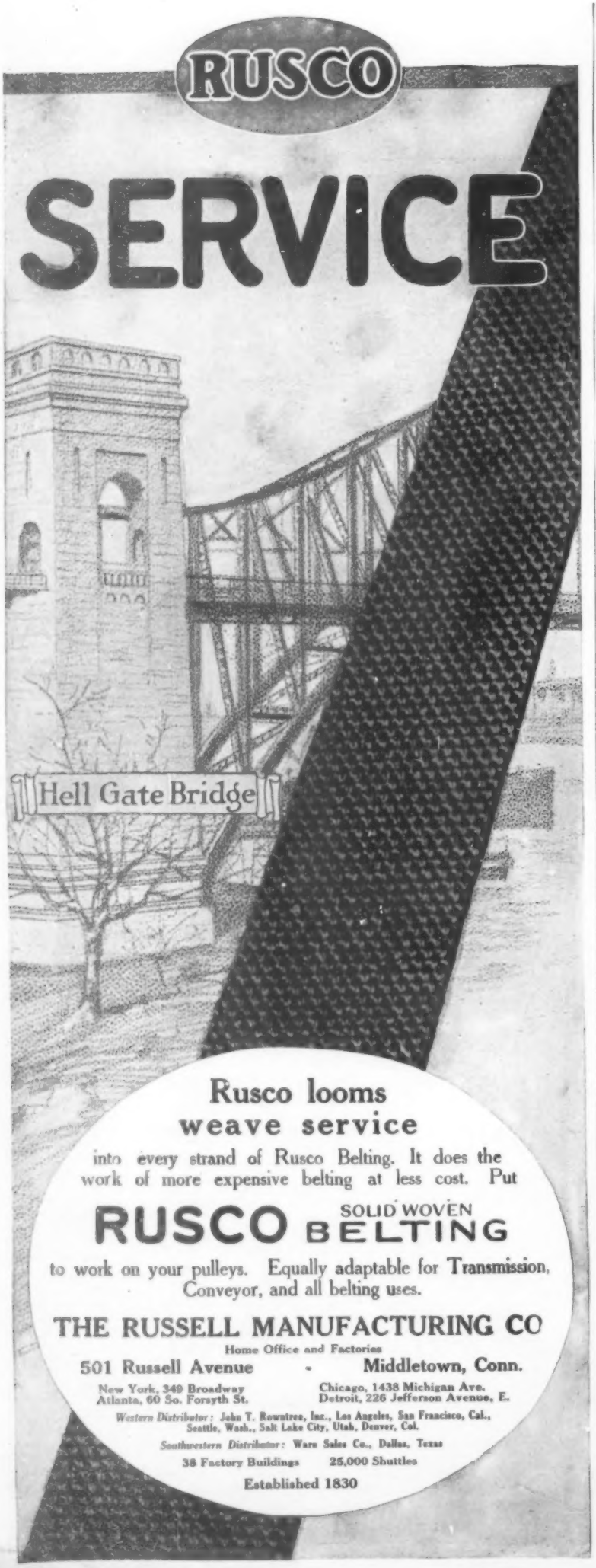
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SERVICE
Hell Gate Bridge
Rusco looms
weave service
into every strand of Rusco Belting. It does the work of more expensive belting at less cost. Put
RUSCO SOLID WOVEN BELTING
to work on your pulleys. Equally adaptable for Transmission, Conveyor, and all belting uses.
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Home Office and Factories
501 Russell Avenue - Middletown, Conn.
New York, 349 Broadway
Atlanta, 60 So. Forsyth St.
Chicago, 1438 Michigan Ave.
Detroit, 226 Jefferson Avenue, E.
Western Distributor: John T. Rowntree, Inc., Los Angeles, San Francisco, Cal., Seattle, Wash., Salt Lake City, Utah, Denver, Col.
Southwestern Distributor: Ware Sales Co., Dallas, Texas
38 Factory Buildings 25,000 Shuttles
Established 1830

Coöperation and Industrial Progress

(Continued from page 142)

Labor are friends, not enemies. We are finding that the objects we are after are one, and that if this common object is to be obtained our method of approach must be along the same line. Capital cannot exist without Labor, and Labor without Capital is helpless. The development of each is dependent upon the coöperation of the other. Furthermore, through employee representation Capital and Labor are finding a very pleasant mutual understanding of each other's problems. Many advocates of employee representation speak of the great benefits to be derived when the men at large understand the problems of management. This is true, but it is also equally important for the management to become educated in the viewpoint of the men. In former years, when an employer ruled one or two hundred workmen, he knew his men individually, and they understood him. Now, on the other hand, the corporation has replaced the individual employer and the employees are numbered by thousands instead of hundreds. It is therefore, impossible for the managers of a business to maintain personal contact with their employees. Industry has gained more efficiency through the development of large units, but the old personal contact between owner and workmen has been lost. Civilization cannot afford to do without the economy of large production, and it is looking to employee representation to bridge the present gap and to bring the men into contact with the management and the management in direct contact with the men.

Those men who object to employee representation argue that employees are more interested in high wages; that they will elect undesirable or incapable representatives; that they will break down the discipline of the shop, and that it is merely an invitation looking toward the ultimate establishing of a closed shop. In reply to those objections I believe that while it may be argued that the point of view I have followed is a matter of opinion, no one has suggested a more constructive arrangement, for settling the differences between employers and employees. Secondly, our experience indicates that as often as not, the men ask for shorter hours rather than higher wages. They are interested in living happily, and they feel that employee representation is giving them a better chance of livelihood.

To others who claim that a group of American employees will not elect men capable of upholding the confidence reposed in them, I quote figures to indicate the stable characteristics of men chosen by the employees of my company as their representatives. The average of these representatives throughout the company is about 37 years. Three-fourths of them are married. Their average employment with the company is over seven years, and a large number own their own homes or stock in the company. They are required by the plan to be American citizens, but that has not prevented the election of a large number of good Americans born in foreign countries, some of whom have proven themselves in common council far above the average ability. I do not pretend to say that we do not have any radicals among the number, but their presence has only served to make the discussion keener and to prove to us that our plan was really democratic in basis. The men, of their own free will, have chosen responsible representatives whose opinions are valuable for what they are. And—the plan works.

A New Method of Filling the Silo

(Continued from page 135)

an eight horse-power engine but the feeding must be proportioned to the size of the blower. By means of an iron rod running from the blower to the wagon elevator, the engine operating the blower also gradually hoists the wagon. A man with a pitchfork shoves the cut fodder from the wagon out into the conveyor where it is fed into the silo.

In the silo one man is able to distribute the fodder and tramp it. One reason for this is that the silo is filled rather slowly, thereby giving the fodder ample time to settle; and when the last is run in, the remainder in the silo is settled all it will and the silo can be filled to the top.

Two 100-ton silos were filled on opposite sides of the road in northern Indiana. The usual work took twenty-five man-days or 250 man-hours which at forty cents per hour means $100 or one dollar per ton. With the new method, the silo was filled with 150 man-hours of labor which at the same rate would be $60 or sixty cents per ton.—*I. J. Mathews.*

Gas and Steel

(Continued from page 136)

change taking place while the steel is undergoing a change in temperature.

One of the most important points to be given careful attention in all heat treating operations, is that of the *"critical range"* of the steel, known as the "upper" and "lower" critical range. These values are not constant but vary according to the carbon content in the steel. The lower the percentage of carbon the greater the difference between these ranges. As the carbon content increases these two ranges approach one another until at 0.85 per cent carbon they merge into one.

The significance of this characteristic in the steel is that during the period of heating between the lower and upper critical range a transformation is rapidly taking place in the constituents of the steel, which begins at the lower critical range, and is completed at the upper critical range. In steel containing 0.85 per cent carbon, this transformation takes place immediately, while for percentages above this amount the transformation is slow.

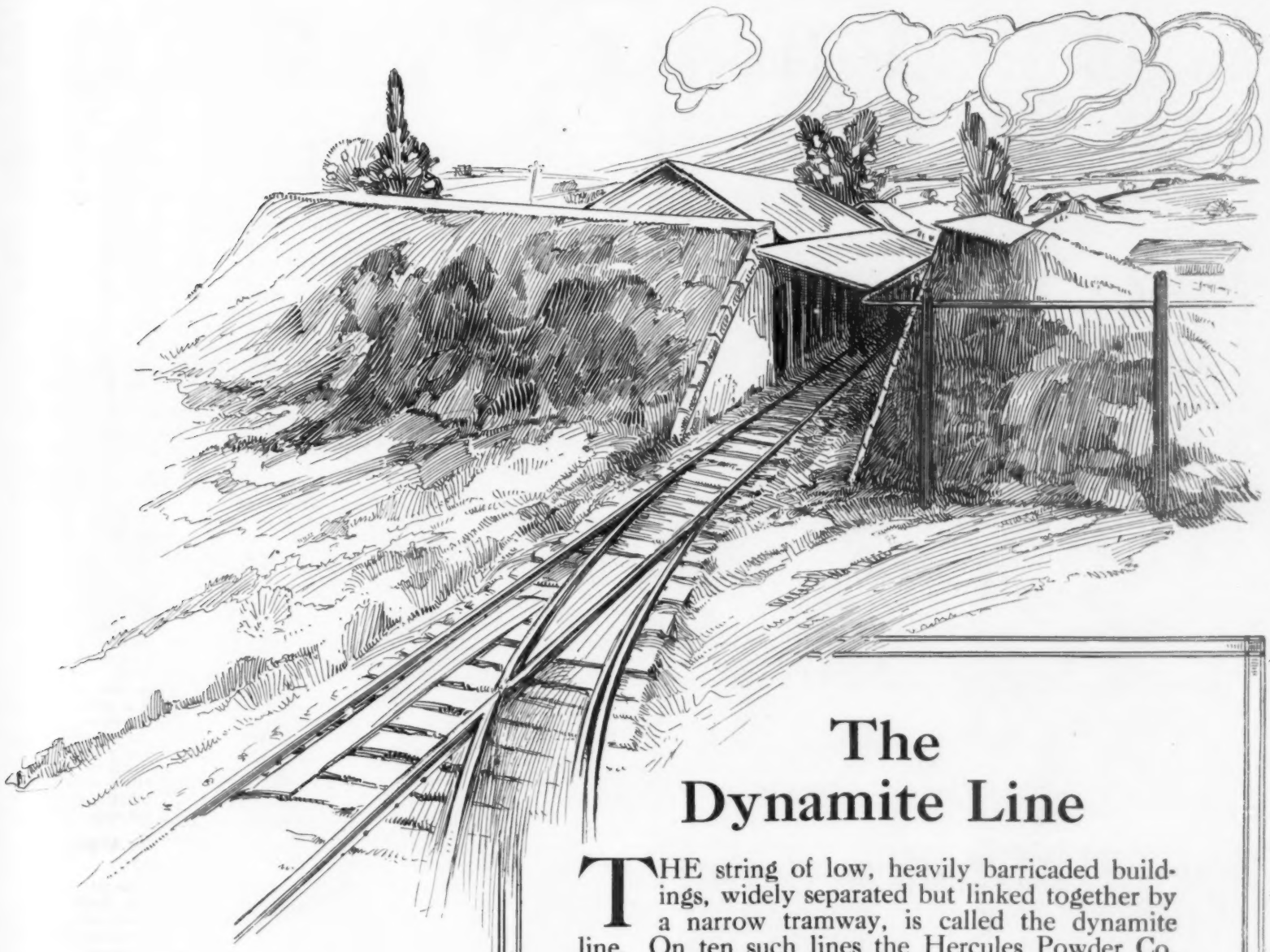
It is important, therefore, to understand this characteristic of steel if the best success is to be obtained in all heat treating work. For complete annealing and hardening it is necessary to know the upper critical ranges in order not to exceed that point. Heating and cooling below this limiting temperature will not give full and complete results and exceeding it more than 50 degrees F. will likewise produce inferior work, by increasing the granular structure of the steel and thus causing brittleness.

Forging

There is probably no heat treating operation in use in which the principles of correct heat application are more abused than that of forging. Here again one would conclude from observing the majority of forging fires in operation that speed and not quality is the aim of the manufacturer. In the majority of forging work today, the steel is heated in oil-fired furnaces, the coal and coke fire having been abandoned on account of their slowness and irregular heating of the metal. A large number of forging furnaces are "makeshift" affairs constructed by a mason with an oil burner applied at one or both ends with little or no thought for economy or quality of the finished product. Such furnaces will produce uneven heating especially where the flame impinges directly on the work nearest the burner.

One of the greatest faults with modern forging work is found in the desire for rapid heating. Under the action of a very intense heat the steel is made to "run" or drip on the exterior before the interior has become properly soaked, consequently there exists a core in the bar which when placed under the hammer does not forge properly. It is very im-

(Continued on page 146)



The Dynamite Line

THE string of low, heavily barricaded buildings, widely separated but linked together by a narrow tramway, is called the dynamite line. On ten such lines the Hercules Powder Co. turns out over 50,000,000 pounds of dynamite in an average year.

The absence of noise and bustle, of whirring wheels and clanking steel, makes a striking contrast to the usual accompaniment of manufacturing production on a large scale. In little rubber-tired buggies the nitroglycerin is delivered to the mixing house just as it is needed, and with equal precision and dispatch the other ingredients arrive via the tram line. From here the dynamite is forwarded in bulk and passes from one small building to another until the last process is complete and the finished product reaches the storage magazine.

* * * * * *

A spark, a sputtering fuse, and the energy stored in these little cartridges of dynamite springs forth with a mighty roar to do our bidding, whether it be to remove a mountain or a stump; to provide copper for our pennies or for our miles of electric wires, steel for our pen points or for our railroads; to mine coal for our factories and hearth fires or jewels for our adornment.

The power supplied to our industries by the makers of explosives, these deft and careful workers on the dynamite line, will produce enough materials to build a city every day.

HERCULES POWDERS

HERCULES POWDER CO.

Chicago	St. Louis	New York
Pittsburg, Kan.	Denver	Hazleton, Pa.
San Francisco	Salt Lake City	Joplin
Chattanooga	Pittsburgh, Pa.	Wilmington, Del.

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IT'S a real satisfaction to be able to do things for yourself and not have to depend on someone else—someone whose interest may not be *your* interest.

Moreover, there is not only satisfaction in doing things for yourself, but there is the element of education in learning how things are done and then doing them.

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Safety, Saving and Service

It is not only *safe* and not only *saves* money for you but its HEALTH BUREAU renders an important service by giving to policyholders the privilege of one free medical examination each year, so as to detect disease in time to check it; and periodical Bulletins on Health-Conservation are also sent free to policyholders.

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FIFTH: Operates under *strict New York State requirements* and subject to the United States Postal Authorities.

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SEVENTH: *Policyholders' Health Bureau* provides one *free* medical examination each year, if desired.

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You will receive full information based on official reports regularly filed with the New York State Insurance Department. Writing places you under no obligation and no agent will be sent to visit you. The resultant commission-savings go to *you* because you deal *direct*.

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Nothing but wireless. One copy will convince you. On all newsstands 15c, $1.50 a year, Canada and Foreign $2.00. Send for free sample.

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will instantly add, subtract, multiply, divide, solve proportion, give any root or power, Logarithms, Sines, Tangents, Cosines and Cotangents. Made of metal. Size 4 ins. Price, with 16-page Instruction Book, $1.00. Your money back if you are not satisfied. Send for our catalogue of slide rule. All types from 50c to $10. Instructions in Logarithms and Trigonometry free with every catalogue.

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Gas and Steel

(*Continued from page 144*)

portant, in order to obtain the best results, that the work should be heated slowly in a soft, reducing atmosphere. Forging temperatures should range from 1,500° F. for high carbon steel to 1,800° for low carbon steel. But instead of these temperatures we find more forging being done at "white heat" which is probably nearer 2,500° F.

High speed steels for cutting tools should never be forged. It is far more economical to turn down such tools from bar stock if the best product is to be obtained. There are, however, quite a large number of such tools being made today by forging operations. A well-known steel drill is being made in all commercial sizes and in large quantities, where the flat stock is heated and twisted into the proper shape and size. They are then hardened and ground to the proper dimensions. The temperature for forging such tools is usually from 2,000 to 2,200 degrees F. and in the product just referred to there is very little hammering done to the steel.

After forging, all steels having cutting edges or bearing surfaces should be reheated to a temperature of from 1,400 to 1,500 degrees F. and allowed to cool slowly. After this operation they must be ground in order to remove a thin coating of decarburized iron existing in all hot rolled steel, otherwise if this surface is allowed to remain, it will prevent hardening.

Until recently the utilization of gas for forging has been considered too expensive in comparison with coal, coke and oil due principally to the lack of efficient gas-heated furnaces.

A highly satisfactory and efficient gas-heated forge is now obtainable, and a number are in actual operation. The furnace is much easier to operate than those heated with other fuels, and requires practically no attention after the desired working conditions are obtained. The burners are supplied by an air-gas automatic proportioning device, which gives a homogeneous mixture, and they can be adjusted to give a slightly reducing furnace atmosphere in order to minimize the formation of scale.

A furnace of the above type was installed recently in the plant of a Philadelphia manufacturer, and after making comparisons between it and a coal-fired furnace, the following results were obtained:

	Coal-fired furnace.	Gas-fired furnace.
Number of pieces handled per 9-hr. day	1,400	2,122
Overall efficiency	6.84%	25.23%

The increased production and superior operating advantages were sufficient to offset a slightly higher fuel cost.

The great advance in the shipbuilding industry during the war gave rise to many innovations. One of the outstanding features of this development was the substitution of gas for fuel, replacing fuel oil in a number of forging operations. Four or five yards adopted it on an extensive scale, and two yards used it exclusively, except for a small amount of coke used in portable rivet heaters.

Automatic Regulator for the Heating Plant

(*Continued from page 137*)

which time the apparatus will automatically shift so as to reduce the force of the furnace at an hour before retiring time. Likewise the day commutator is adjusted so as to become effective at about an hour prior to rising time in the morning, so that the rooms are becoming comfortably heated by the time the family are astir.

It will thus be seen that by maintaining the living rooms at a moderately low temperature during the night a material saving in fuel is effected and without any discomfort, in view of the fact that the rooms are heated in due time in the morning. Moreover the greater consideration in the economy of fuel lies in the fact that at no time during the day is the furnace permitted to become overheated. Perhaps the most common source of waste in fuel is due to the combustion of fuel to a greater extent than is needed or desired, resulting either in the discomfort of the individuals or the throwing open of doors of windows in an effort to reduce the temperature to a comfortable degree.

As already stated these operations are all automatic and moreover the clock is kept wound automatically from the same motor that operates the draft devices. All the operator is required to do after the device is installed is to keep the furnace supplied with fuel and otherwise in proper operating condition and to see that the clock is running substantially true to time, and the device does the rest.

Generating Electricity at the Mines

(*Continued from page 137*)

square yards and are housed in four buildings, is obtained from the Golpa mine near by and is carried to the plant by an automatic system of cable cars. About 5,000 tons of coal are used daily. There are eight steam turbines, each capable of generating 16,000 kilowatts, located in a single room almost 300 feet long. The chimneys of the power plant tower to a height of 300 feet. The employees number about 750, and are housed in pretty cottages in the vicinity. The high power transmission line from the power plant to Berlin ends in a suburb of the capital, known as Rummelsburg, where a substation is located for stepping down the current to commercial voltages.

The German Government, in line with the plans for socialization of the electrical industry of the country, has taken over the stock of the company.

Collapsible Wings for Airplanes—Why Not?

(*Continued from page 139*)

A New York inventor, John Arthur Weis, has recently come forward with an ingenious contractable airplane wing, for which he claims ample strength, reliability and convenience. In fact, a British aircraft manufacturer has begun construction on a machine with this type of contractable wing. In order to produce a wing that may be folded automatically and almost instantaneously, this inventor has replaced the usual rigid spars with a collapsible construction, similar to the well-known lazy tong telephone holder but provided with suitable stop locks. In extending the wing fully the links of the lazy tong construction lie parallel to each other and are prevented from moving in the opposite direction by the aforementioned stop locks. At this point the lazy tong action ceases, and the construction becomes rigid. Since there are no folds or pockets in the airfoil or wing surfaces, each section of the wing can be covered independently with fabric or sheet aluminum. Provisions are made for having the airfoils airtight, despite the many sections.

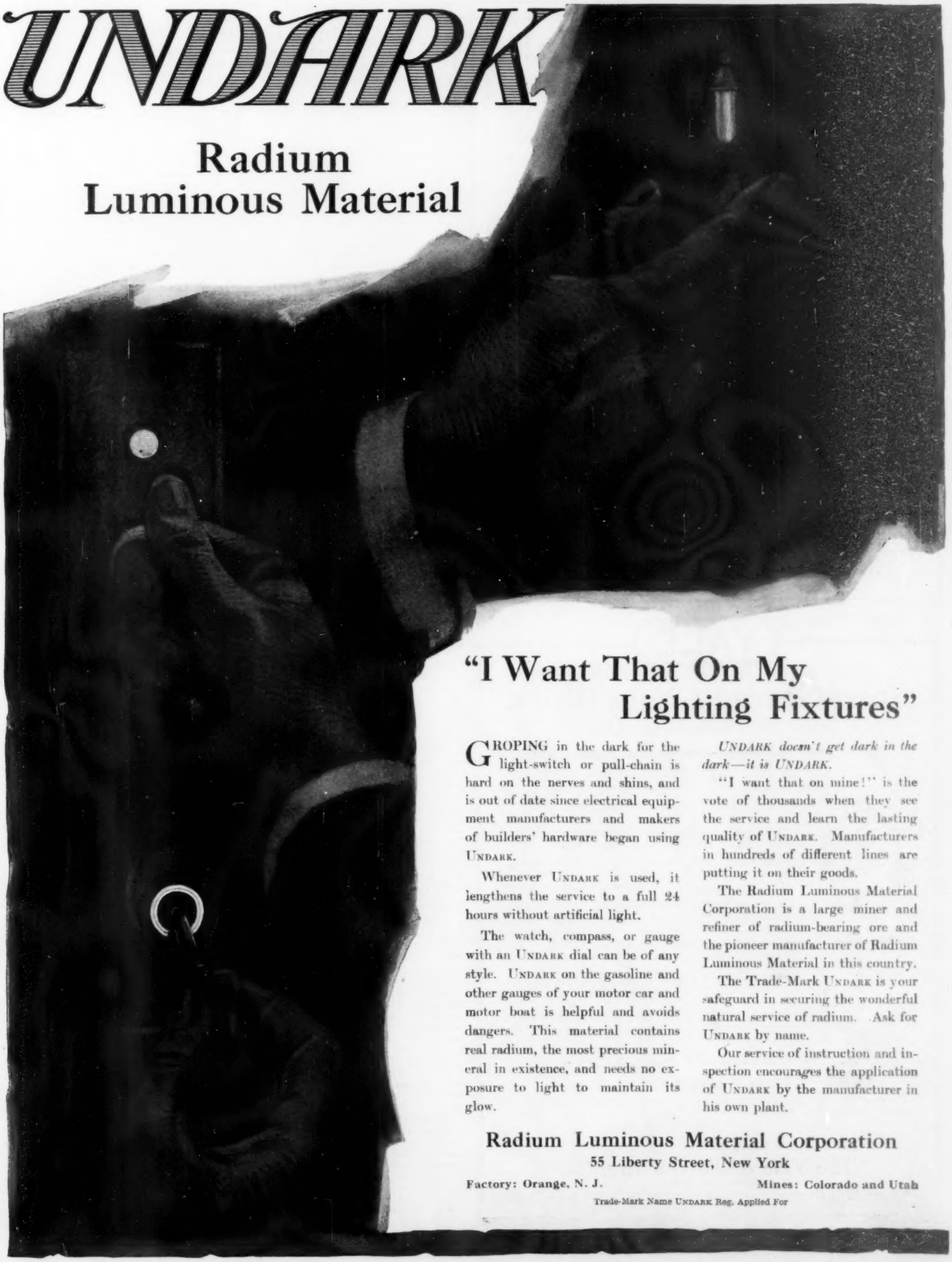
All important and vital members, such as distance bars, ribs, struts, stabilizers, and so on, remain intact and undisturbed. When the spars are brought into a straight line, the ailerons are in position to work on hinges just like those of any present rigid standard types, according to the inventor. The pilot can expand or contract the wings by means of a crank or lever in the cockpit. If desirable, a very simple device in the form of a little ratchet drum, worm-driven, in connection with a handwheel and dial, enables the pilot to apply the necessary tension to the interplane bracings as soon as the wings are fully extended and locked.

According to this inventor, the span of

(*Continued on page 151*)

UNDARK

Radium Luminous Material



"I Want That On My Lighting Fixtures"

GROPING in the dark for the light-switch or pull-chain is hard on the nerves and shins, and is out of date since electrical equipment manufacturers and makers of builders' hardware began using UNDARK.

Whenever UNDARK is used, it lengthens the service to a full 24 hours without artificial light.

The watch, compass, or gauge with an UNDARK dial can be of any style. UNDARK on the gasoline and other gauges of your motor car and motor boat is helpful and avoids dangers. This material contains real radium, the most precious mineral in existence, and needs no exposure to light to maintain its glow.

UNDARK doesn't get dark in the dark—it is UNDARK.

"I want that on mine!" is the vote of thousands when they see the service and learn the lasting quality of UNDARK. Manufacturers in hundreds of different lines are putting it on their goods.

The Radium Luminous Material Corporation is a large miner and refiner of radium-bearing ore and the pioneer manufacturer of Radium Luminous Material in this country.

The Trade-Mark UNDARK is your safeguard in securing the wonderful natural service of radium. Ask for UNDARK by name.

Our service of instruction and inspection encourages the application of UNDARK by the manufacturer in his own plant.

Radium Luminous Material Corporation
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Factory: Orange, N. J. **Mines: Colorado and Utah**

Trade-Mark Name UNDARK Reg. Applied For

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The No. 14 **Ratchet Counter** above registers one for each throw of the lever, recording number of machine operations. Supplied with outside stops which regulate the throw of the lever, and having return spring action which automatically returns the lever into position for the next count. The lever is adjustable, allowing the counter to be used at any angle. Price, $2.25

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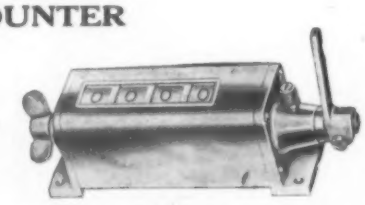

This large **Set-Back Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra.

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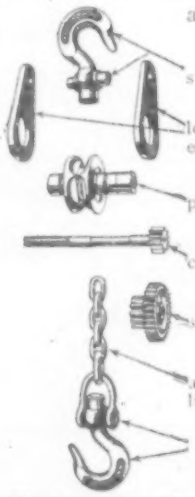

Steel Safety Hook and Crosshead. Both are steel forgings designed to swivel and rock.

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Recently Patented Inventions

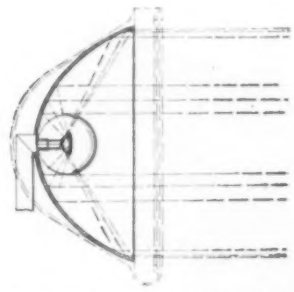
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

AEROPLANE.—W. P. BETUSOV, Tampa, Fla. This invention has for its object to provide in an aeroplane of any character means for preventing the machine from rocking and skidding, also means for preventing banking and skidding and means for preventing nose dives to bring the machine back to a normal stage.

Electrical Devices

INCANDESCENT ELECTRIC LIGHT.—M. C. CAUGHREAN, Ketchikan, Territory of Alaska. The object of the invention is to provide an electric light globe having a reflector whereby certain rays of light, which would ordinarily diverge, are reflected toward the main paraboloic reflector from which they are again reflected in a direction more nearly parallel to the axis of the main reflector thereby condensing the light. The invention specially relates to searchlights, spot lights, and head lights for automobiles.



A SECTION THROUGH AN AUTOMOBILE HEADLIGHT FITTED WITH THE INVENTION

Of Interest to Farmers

ATTACHMENT FOR HEADERS.—S. S. and E. F. THOMAS, Pampa, Texas. The invention has for its object to provide an attachment for converting a horse drawn header into a motor header. The motor is controlled from the platform by means of flexible members which are connected with the controls of the motor, and which pass over pulleys on the auxiliary frame to the platform, and to suitable controlling levers. In attaching the attachment to a header, the only changes required are the addition of the gear wheels.

Of General Interest

TROWEL.—W. I. HARE, 143 E. 39th St., New York, N. Y. This invention relates to a trowel for the use of gardeners, florists and other persons; its object is to provide a trowel arranged to permit the user to readily pulverize the earth and loosen the roots of weeds, for which purpose part of one side is provided with teeth, triangular in shape. An other object is to provide a trowel which is exceedingly strong and capable of withstanding rough usage.

BUTTON.—M. WIENER, c/o Dubbie Button Works, 12 W. 21st St., New York, N. Y. The invention particularly refers to buttons such as are commonly used for fur coats, overcoats, cloaks or the like. Among the objects is to provide a composite button of a superior strength and durability, and that may be made at a low cost. A special feature of this form of button is the fact that by virtue of the means for interlocking the back and face disks, the facing disk may consist of stock of much less caliber than is ordinarily used.

SHAVING-CUP. S. L. HARWOOD, Uniontown, Ala. The general object of the invention is to provide a shaving-cup adapted to accommodate an insertible cartridge containing shaving cream and with a fountain thereon together with a valve means for discharge of the desired quantities of cream into the fountain. The arrangement leaves a clear opening when the valve is raised but there is not presented such an opening as would be clogged by the hardening of the cream.

ADJUSTABLY-ENGAGING SUPPORT.—C. E. LLOYD, 216 W. Romana St., Pensacola, Fla. The invention relates generally to adjustably-engaging supports capable of use either as ironing tables, cot beds and the like, and particularly to an arrangement of that nature including a frame and a body member swingingly disposed in the frame, these parts being flexibly connected to one another in such manner as to present relatively opposing portions acting as a clamp to engage sections of a table, automobile running board or the like.

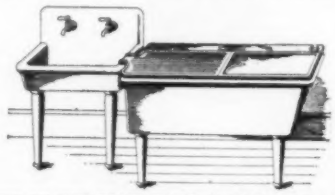
POWDER PUFF.—L. R. ROSE, 817 Chapel St., New Haven, Conn. This invention relates to powder puffs and more particularly to an article of this kind having a surface penetrable by the powder, and a filling device for the container, constituting a handle for the manipulation of the article. An object is to provide a simple and durable powder puff, which is compact in form but can contain a considerable quantity of powder, which in use will not escape to the fingers of the user.

BELT BUCKLE.—O. SELLE, 705 Locust St., St. Louis, Mo. The prime object of this invention is to provide a device in which the tang of the buckle may be readily engaged with or disengaged from the free end of the belt. A further object is to provide a device in which the greater the strain imparted to the tang of the buckle, the tighter it engages the free end of the belt.

DISINFECTING GARBAGE-CAN COVERS.—J. G. SERAPHINE, 507 W. 184th St., New York, N. Y. This invention has to deal more particularly with a disinfecting means arranged in the cover of the receptacle whereby the latter can be kept in a sanitary condition. A more specific object is the provision of a liquid container incorporated in the cover of the can, having a valve-controlled means for permitting the disinfectant to be sprayed into the garbage.

BASKET AND PACKAGE.—H. E. BROCK, c/o Superior Box and Novelty Co., Hancock, Mich. The object of this invention is to provide a crate or basket composed of wooden slats, joined together by metal wires, wherein the structure of the crate or basket may be quickly built up and will be held firmly in place by the wires. Since no staples are used there is no danger of splitting the slats and very thin slats may be used.

DRAIN TABLE.—D. F. LOUDON, 109 W. 102nd St., New York, N. Y. The object of the invention is to provide a drain table arranged to permit the plumber to properly fit



VIEW OF THE DRAIN TABLE ARRANGED AS COVER FOR A WASH TUB

the drain in position on a wash tub with the spout in proper engagement with the sink. Another object is to provide a drain table which is strong and durable and not liable to warp or lose its shape by the weight of table-ware, cooking utensils and like articles placed upon it.

TOBACCO STICK.—G. T. SULLIVAN, 109 W. Blont St., Kingston, N. C. Among the objects of the invention is to provide a tobaco stick of a simple construction thereby enabling the consequently expeditious fastening of the tobacco leaves in place in the stick, the construction being such that the leaves will be retained under all circumstances through the final curing stage.

METHOD AND APPARATUS FOR PRODUCING STROBOSCOPIC EFFECT.—L. E. DODD, 4048 Mifflin St., Pittsburgh, Pa. The invention relates to means for producing stroboscopic effect, such, for instance, as is required in an alternating current frequency meter or in a tonoscope for indicating the absolute pitch (vibrations per second) of a sounded tone, whether sounded by a voice or by any instrument capable of emitting musical notes. This invention is more fully described in the SCIENTIFIC AMERICAN of Nov. 4, 1916, in an article entitled "Letting the Eye Train the Voice."

PHOTOGRAPHIC RECORDER. — W. C. DURYEA, Princeton, N. J. Among the objects of the invention is to provide a photographic recorder having among others the following functions: First, for use as a recording chronograph, to record or register the movement of an oscillograph, a moving coil galvanometer or string galvanometer, for use in the examination or study of pulsations of the heart

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contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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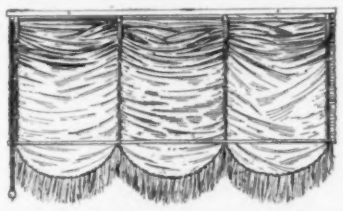
through the instrumentality of an electro-cardiograph, and also for recording telegraphic, cable or wireless message, signals or the like.

REGULATING DEVICE FOR THE FLOW OF LIQUID IN ORDNANCE BUFFERS.—E. RIMAILHO, Paris, France. The object of the invention is to accurately regulate the flow of the liquid in an ordnance buffer according to the angular displacements imparted to the gun by automatically varying the area of the flow-orifice. Said device is equally adapted to be applied to a hydraulic buffer or to a hydropneumatic buffer, in which the liquid at rest is under pressure or not.

WHEELED GUN-CARRIAGE.—E. RIMAILHO, Paris, France. The invention relates to a wheeled gun carriage comprising an axle wheel member, an arched trail frame, trail beams, a ball and socket joint coupling the axle wheel member to the trail frame, one of the said trail beams being rigidly connected to the trail frame, means connecting pivotally the other trail beam to the arched member so that the beam may be folded against the first named beam, and means for connecting the two beams in folded position.

LENS HOLDERS FOR EYEGLASS MOUNTINGS.—O. Y. LADD, 5 White St., Danbury, Conn. This invention relates more particularly to the lens holding means of rimless eye glasses, in which pivoted levers are mounted upon the bridge piece and the lenses, may be made rigid, and a reinforcement for, rather than a weakening of the lenses.

CURTAIN HANGER.—W. ANDRESS and C. F. NEUMANN, 19 Nickle St., Corona, L. I., N. Y. Among the principal objects of the invention are to dispose the window shades known in the trade as "cloud shades" in parallel elevated



AN ELEVATION SHOWING THE INSIDE OF A WINDOW, WITH SHADE PARTLY RAISED

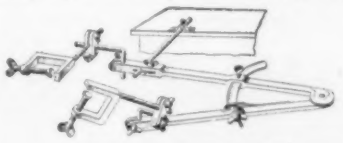
positions without changing the initial arrangement of the folds, to perfectly arrange the folds by distributing the supporting strain of the folded portions, and to simplify the construction ands facilitate the handling of shades of the character mentioned.

Hardware and Tools

SAFETY-LOCK FOR DETECTING THE VIOLATION OF CONTAINERS.—S. A. GARCIA, Box 333, Guadalajara, Mexico. In this invention the lock consists of two sheet metal sections, one of which may be attached to the body of a box and the ther to the cover, the said sections interlocking when pressed together to prevent entrance to the box without disclosing that it has been opened. That is the arrangement is such that the lock must be destroyed or torn from the container to gain access to the interior thereof.

GATE-VALVE DISK.—O. L. WHITEMAN, Coxsackie, N. Y. The invention relates more particularly to the closing mechanism of gate valves. An object of the invention is to provide adequate means for raising and lowering gate sections into the valve seat within the valve casing in order to close the valve passage. A further object resides in a form of carrier for supporting the gate sections, the arrangement is simple in construction and unlikely to get out of order.

WORK CLAMP.—A. C. TREUTHARDT, Georgetown, Texas. The invention particularly relates to work holding apparatus, or clamp tongs used for the purpose of holding machine parts during repair. An object is to provide work



PLAN REVIEW OF THE DEVICE

or clamp tongs which may be installed in some fixed position and used for the purpose of holding metal parts to be welded, brazed or otherwise repaired. A further object is to provide adjustable tong legs upon which are mounted universally swivelled clamps.

CLAMP.—J. D. BENNETT, Route 1, Conneaut, Ohio. The object of this invention is to provide a clamp especially adapted for holding the transmission bands of a planetary transmission

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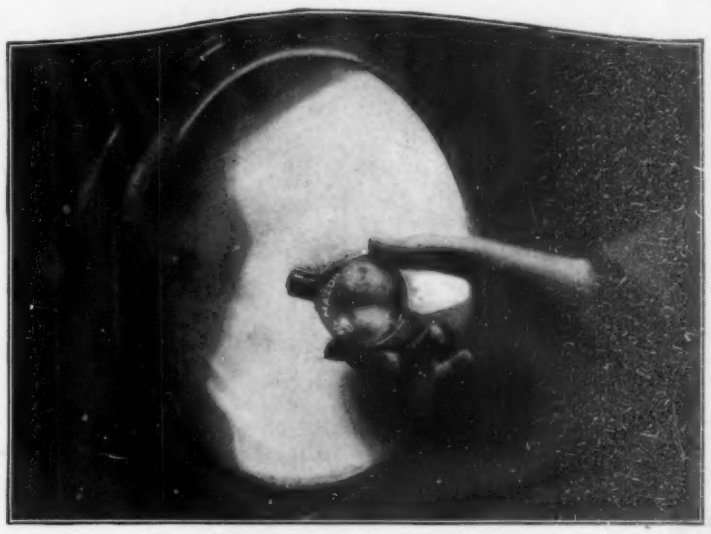

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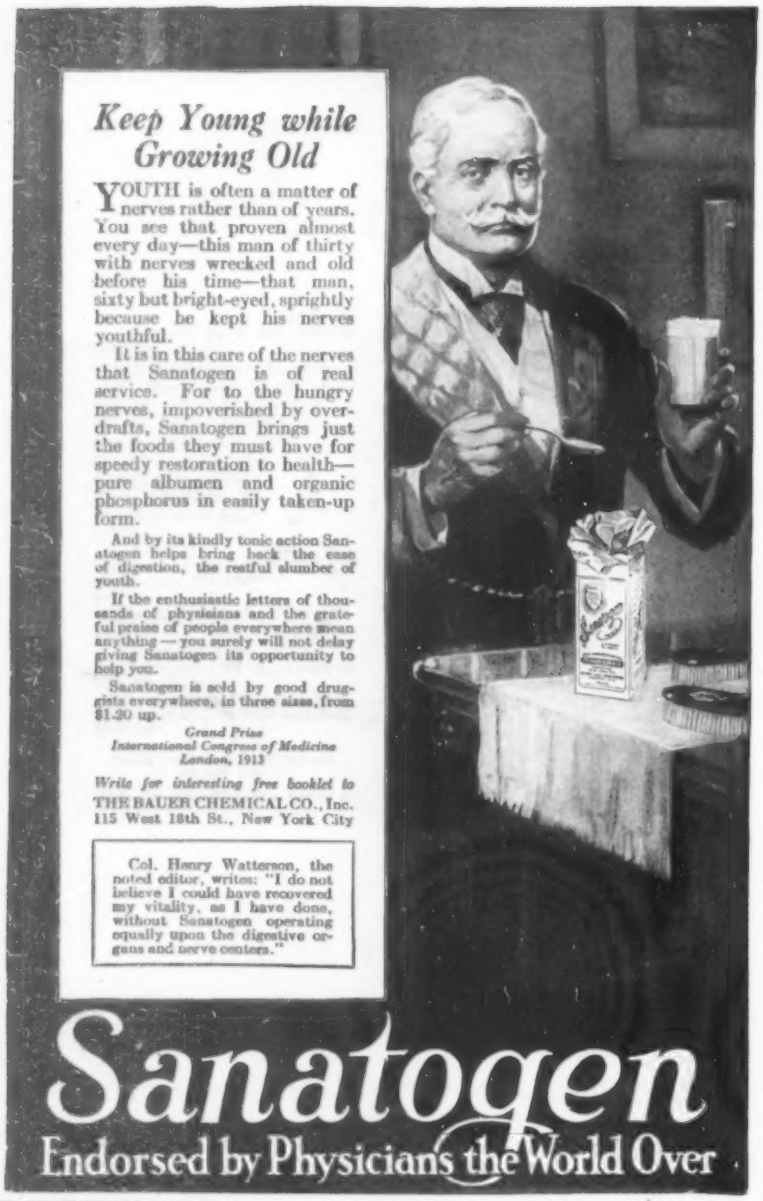
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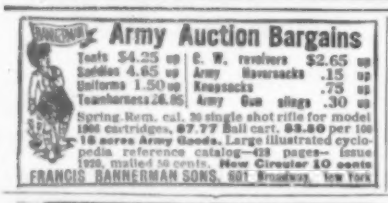
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during assembly, wherein the clamp is so arranged that the pressure on the band will be equalized during the assembling.

Heating and Lighting

TANK HEATER.—W. TINKER, Anamoose, N. D. The invention has for its object the provision of a device of the character specified for use in preventing the freezing of water in tanks, which may be partly submerged in the water in the tank and which will burn while so submerged, and which while so submerged may be fed with fuel.

Machines and Mechanical Devices

RADIAL-ARM DRILLING MACHINE.—F. COXON, Birmingham, England. The object of the invention is to provide means for actuating the arm locking mechanism and also the clutch of the mechanism of radial arm drilling machines whereby the arm is raised or lowered. The invention comprises the employment of a hand-operated shaft connected to both the locking mechanism and the clutch.

LOOSE PULLEY.—C. H. RHODES, 300 Comstock St., Owosso, Mich. The invention has for its object to provide mechanism in connection with the loose pulley for lubricating the same during the running of the pulley. The bushing has a longitudinally extending passage in its wall, and a bent tube leads from this passage radially, when the pulley is rotated, the lubricant is thrown outward by centrifugal force, the bent end of tube moving in the lubricant as the pulley rotates.

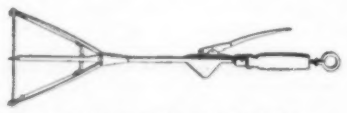
VALVE.—W. E. NESTOR, Box 607, Waynesburg, Pa. The special object of the invention is to provide a valve designed for the inlet or discharge valves of gas or air compressors wherein the valve is a plate normally spring pressed into closed position, and adapted to open under pressure, and wherein means is provided for regulating the extent of opening of the valve and the tension of the spring.

MECHANICAL DISPLAY DEVICE.—E. A. DIETERICH, 910 Caldwell Ave., Bronx, N. Y. The object of the invention is to provide a mechanical display device designed for use in show windows, Christmas trees, toy structures and the like, and arranged to display merchandise, Christmas lights or candles or other objects in a very attractive manner by causing such objects to travel along a prescribed endless course.

REAMER FOR OIL AND GAS-BEARING SAND.—A. OTTO, 209 Scarrett Bldg., Kansas City, Mo. The invention relates to reaming devices for oil wells, and has for its object to provide a construction which will quickly, substantially and evenly remove the sand and deposit thereon adjacent the bore of the oil well with a minimum effort: the reaming members are spread and maintained in a spread condition by the action of steam, gas, or compressed air, whereby they may accommodate themselves to the particular shape of the sand being reamed.

Medical Devices

FORCEPS.—E. ODELL, Central City, Neb. The object of the invention is to provide an instrument especially adapted for the use of veterinary surgeons as obstetrical forceps, wherein a series of blades is provided, mounted to move toward and from each other, but



A PLAN VIEW OF THE FORCEPS

without touching at their edges, and flexible means in connection with the blades for gripping the object to be removed, the flexible means being controlled to grip in cooperation with the closing movements of the blades.

Musical Devices

VIOLIN BREAST-REST.—W. H. HAMMACK, Hagerstown, Md. An object of the invention is to provide a breat-rest for violins, capable of being clamped at any desired place on the right bout of a violin and including an adjustable padded rest piece for bearing on the breast of the performer, thus affording a support between it and the chin of the performer.

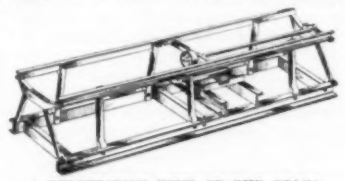
Pertaining to Recreation

TOY.—E. E. ALLSTATTER, 154 Progress Ave., Hamilton, Ohio. The invention relates to toys and has for its object to provide a toy of the motion type, wherein the representation of a figure is provided, suitably mounted upon a base and connected with means for causing the figure to dance a jig upon the support. To cause the figure to dance it is only necessary to vibrate a lever.

AQUATIC TOY.—W. E. LAWSON, Union Bldg., Newark, N. J. The object of the invention is to provide an aquatic toy more especially designed to simulate a marine vessel such as a submarine, and arranged to be submerged in a body of water, to be moved along in the body of water and caused to rise to the surface and travel along the same at the will of the operator. Another object is to automatically fire toy torpedoes, toy guns or similar weapons.

Pertaining to Vehicles

MOTOR ASSEMBLING AND TESTING STAND.—W. G. HARPER, Carlisle, Ky. The invention has for its object to provide a stand which may be used for adjusting the bearings of a motor to the crank shaft by



A PERSPECTIVE VIEW OF THE STAND

heating, termed "burning in," and for loosening the bearings by turning the same with a motor after they have been "burned in," termed "running in," and for assembling and testing the motor.

PUNCTURE-PREVENTING MATERIAL FOR TIRES.—T. V. EDMUNDS, O'Hanlon Bldg., Winston Salem, N. C. The invention relates particularly to a composite material to render automobile and other pneumatic tires practically puncture-proof, without giving rise to other and even more serious objections, such as overheating and undue wear and deterioration. More specifically the inventor proposes the use of metallic wool, matted, woven or compressed, with graphite, and either with or without opposite layers of asbestos for head insulation.

TIRE-BUILDING CORE AND CHUCK.—P. and B. DE MATTIA, Garfield, N. J. The invention relates to a tire building core and chuck of that type embodying a collapsible core and it has for its object to facilitate the stripping or removal of the tire shoe from the core and provides means whereby the supporting chuck may be adapted for use with cores varying in external diameter. A further object is to so construct the core that the movement of the sections will be substantially free of interference with each other.

COOLER FOR INTERNAL-COMBUSTION-ENGINE RADIATORS.—S. BARUCH, 133 Mercer St., New York, N. Y. The invention for its object to provide a cooler for internal-combustion-engine radiators, with which is combined a water level indicator for the radiator. When the vapor is condensed it will flow through perforations in the lower part of the cooler tube back to the radiator; the water is below a predetermined level, the lowering of a ball will indicate the fact to the driver of the car.

WAGON-COUPLING.—R. G. CRUM, Virginia, Ill. The invention has for its object to provide a simple inexpensive, easily applied device for connecting draft apparatus, as for instance, a tractor to the tongue of a wagon. The invention consists of an upper and olwer sections, the sections being formed from sheet metal of suitable weight; they are curved transversely to fit the peripheral surface of the tongue of a vehicle.

RADIUS BRACE.—S. C. WALLACE, Ruston, La. This invention relates to what is commonly known as a radius-rod brace, the object being to provide a brace for the conventional radius rod which shall strengthen the same, the application of such brace to the rod not necessitating any change of construction in the conventional arrangemet of parts; the device may be quickly applied or detached from a position between the front axle and the inner ends of the radius rod.

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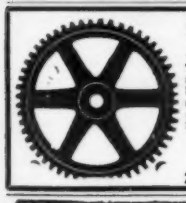

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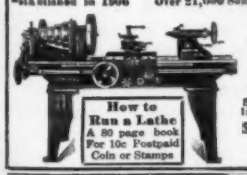

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Collapsible Wings for Airplanes—Why Not?

(Continued from page 146)

a 60-foot machine can be reduced by the contraction of the wings to about 8 feet. The extra weight on a two-seater 110-horse-power biplane is about 100 pounds, consequently the loss in velocity is hardly more than 2 or 3 per cent. When the wings are fully contracted the outlines of the machine resemble somewhat those of a grasshopper. All in all, the construction is most ingenious, but one must hesitate to pass on the practicability of this construction until it has undergone actual application to full-sized airplanes.

Unit Oxygen-Hydrogen Generator

(Continued from page 140)

pacity sought. The generator is a thin rectangular box to which are bolted two cast-iron side plates or electrodes. The cavity thus formed is divided between the electrodes by a diaphragm of asbestos fabric, clamped directly by metal and not depending on either rubber or cement of any kind. This forms two chambers. In the upper part of the cast-iron frame are reservoirs for the electrolyte, from which it is fed to the two sides of the diaphragm. The two gas chambers which permit the separation of the gas from the moisture and electrolyte are also located in the upper part of the frame of the cell, and serve as gas traps and gas off-takes, as well as an automatic pressure-controlling device. At the bottom of this frame are the communicating passage ways which permit the equalization of densities in the electrolyte. Each cell is permanently secured to an eyebolt, facilitating the handling of the cell and shifting it from place to place. With each installation there is used a special plug valve or draining device which permits the electrolyte to be drained from the cell when desired, eliminating the inconveniences of the ordinary valves which are sometimes used in draining caustic liquids.

The diaphragm is a specially prepared asbestos fabric with a thickness and a texture, which have been worked out by long experiences. While it is sufficiently porous to permit saturation by the electrolyte and thus minimize electrical resistance, it prevents the passing of gas from one side to the other. The entire absence of any scale or solid matter in the solution prevents the clogging of the pores of the fabric. The edges of the diaphragm, all around, are held between a flange projecting inward from the frame, and a metal clamping rim bolted to this flange. An absolutely gas-tight joint is thus secured without any packing or gaskets of any description.—*F. C. Perkins.*

Training Men for Foreign Fields

THE survey of export trade planned by the National Committee of Fifteen on Education and Preparation is among the most important moves being made by the United States for the expansion of our foreign commerce after the war. Dr. E. L. Swiggett, expert in the Bureau of Commercial Education, is responsible for the idea. In coöperation with the Bureau of Foreign and Domestic Commerce and the Association of Urban Universities the situation in fifteen principal cities of the United States will be surveyed, and it is likely that the movement will eventually become national in scope.

Questionnaires will be sent to manufacturers, banking and credit houses, export commission firms, and others in order to ascertain the volume and the character of our export business, the number of persons engaged, and the kinds of services rendered. The extent to which local schools and colleges can train efficiently for foreign trade will be investigated. The information obtained will be used as the basis for a course of study that, it is

New Shaving Comfort

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IF you knew of a way to make your daily shave easier, quicker, more comfortable you would use it. There is such a way. Shavaid provides it. A Free Trial Tube will enable you to prove it to your own satisfaction.

Perfected after many tests and experiments, this scientific preparation accomplishes instantly what the old methods failed to do. One application softens the beard perfectly. It soothes a tender skin.

Makes Shaving a Luxury

Men the nation over are adopting this modern method of easier, quicker, pleasanter shaving. They welcome it as a long needed improvement over old ways. Every man who tries Shavaid once uses Shavaid thereafter.

For Shavaid does away with hot water applications, with rubbing the lather in. Men have clung to these old fashioned harsh methods because they have thought they were necessary. They are not. They are injurious to the tender skin.

Softens and Soothes

The soothing, cooling effect is noticeable as soon as you apply it to the dry beard. Then lather. Don't rub the lather in. The lather stays moist and creamy.

Shavaid

Softens the beard instantly
—apply to dry face before the lather.

Saves time and trouble
—no hot water, no "rubbing in" of the lather.

Protects the face
—skin remains firm and smooth.

Removes the razor "pull"
—harsh ways age the skin prematurely.

Replaces after-lotions
—Shavaid is a cooling, soothing balm.

And as you shave, note how the blade "takes hold" without pulling. That is because the beard is thoroughly softened, prepared as it should be.

No need of lotions or creams after a Shavaid shave. No injury has been done to the tender skin. There is no need for medicaments. On the contrary, your skin is smoother, firmer, healthier, from Shavaid's healing influence.

Men who shave close find Shavaid wonderful. The burning, stinging sensation they used to feel after shaving is gone. They know real shaving comfort at last.

It Is Worth Trying

All that is necessary, in order to introduce this remarkable new aid to shaving comfort, is to get men to try it—just once.

No man who shaves once with it will be without it again. For shaving, instead of an irksome task, becomes a positive pleasure.

That is why we want you to send for your Free Trial Tube. Just fill in the coupon and mail it now, before you forget it. When your tube comes, use Shavaid. After the trial tube is used up, you can get Shavaid from your druggist at 50 cents a tube. If he hasn't it, we will be pleased to fill your order direct.

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hoped, will present the fundamentals of the subject in a practical way and prepare students to take part in the intensive exporting that will soon become a commercial necessity.

The man who goes abroad to represent an American firm, as well as he who remains in this country and negotiates with the merchants of other nations, must know the language and the customs of those with whom he deals. There has been too great a tendency to generalize and too little an inclination to specialize in the foreign trade courses offered by American educational institutions. We have not taken the subject seriously enough. When the international market resumes its normal aspect and all nations are able to compete in it, the United States will suffer heavy losses unless our commercial army measures up to the trade forces of our competitors. American products have entered numerous fields during the war which they did not reach previously, and to our old customers we have sold goods valued at millions of dollars more than our prewar exports. This trade has come to us voluntarily, but it will not continue when other suppliers reopen their stores unless we take active measures to retain it. We cannot prepare more effectively than by training men without delay.

Marking American Goods

ONE of the most frequent questions that arises among manufacturers just entering our export trade is whether or not their goods must be marked "Made in the U. S. A." Great Britain and most of its colonies have laws which prohibit the use of misleading indications of origin. In India and Ceylon it is held that the use of English words on goods not of British manufacture must be qualified with a definite statement as to the direct country of origin. Unless the American exporter marks his products "Made in the United States of America," he is likely to encounter difficulty and delay in connection with his shipments to these parts of the British Empire. If goods are marked with the name of some city of the United States such as Worcester or Manchester, which suggests British origin, the name of the city must be followed by the name of the country.

In certain other nations there is a general rule that goods bearing words in the language of the country should be accompanied by an indication of American origin. This is particularly true in France. If there is any French wording, reference to the American source of the product should be made. The same principle applies in the Scandinavian countries, in Spain and in Brazil. As a rule, goods produced in the United States that bear no marks or words of any nature do not have to carry the phrase "Made in the U. S. A."

Domestic Legislation Undesirable

A BILL was presented in the Massachusetts Legislature providing that manufacturers of any article which is intended for export from that State shall mark either on the article or on the package in which it is shipped, "Made in Massachusetts, U. S. A.," and imposing a fine for violation of this provision. Among the objections placed were, first, that it would be unfair to apply such legislation to all sorts of products, and second, that far too many regulations harass our foreign trade now without the addition of others. In the absence of special requirements in foreign countries, it should be optional with the American manufacturer whether or not his goods be marked.

An American commission house desired to send to India a large quantity of labels printed in the United States to be affixed to packages of tea grown in India. The problem was whether to put "Made in the United States of America" on each label or on the outside of the package. It was suggested that such words on the labels themselves would indicate that the tea was an American product, and would therefore be misleading. The designation was actually placed upon the wrapper of each small bundle of labels, and upon the outside of the packing cases.

American shippers have been warned against placing any distinguishing marks upon containers sent to certain Latin-American ports where pilferage is common. American products are known the world over for their real worth, which makes them an attractive prize for the freight pirate.

Germany's Power Problem

A LAW nationalizing the electric power of the German Empire has been published by the government. Germany has over 4,000 power establishments, and the splitting up of their activities is held to cause serious waste. The scheme is made imperative by the loss of the Saar coalfields and the obligation to supply coal to the Allies. The water power, which is mostly to be found in South Germany, is primarily to serve local industries, but an agreement will be made with those generating electricity from coal in central Germany. Power stations belonging to States and municipalities will not be disturbed, but the large plants belonging to private capital will be taken over and nationalized by the Central Government. The Government will buy up shares, so that the present organizations can remain intact. The nationalized works are not to be considered as a source of revenue, as the Government holds that cheap power for industry is more important than fiscal interests. The private capital in electrical power works in Germany is estimated at 1,000,000,000 marks and the use of electrical power in that country has increased from 4.43 billions of kilowatt hours in 1907 to 22 billions in 1917.

French Coal Situation

THE coal shortage in France continues to be serious though some relief has been afforded by the arrival of American coal. Despatches from Berlin indicate that the Ruhr region is about ready to deliver coal to France and that about one million tons may be expected the first month. Discouraging reports have been made by the Mining Society of Lens after investigating the damage inflicted by the Germans on the Lens collieries. Eighteen months will be required to pump out the water, according to their estimate, and work cannot be resumed even on the copper seams until the end of 1920. They will not be in condition to produce on their normal pre-war scale for ten years. The water is flooding out from the lower level mines and causing much damage to the country side. Powerful electric pumps, which will obtain their power from the generating station at Harnes, have been ordered for the work of clearing the mines.

Every time a nation feels the pinch resulting from a shortage of coal and a dependence on foreign sources for this essential, a stimulus is given to the development of the internal hydroelectric resources. A bill has been submitted to the Chambre des Deputés providing for the utilization of the water power of the River Rhone. Twenty hydroelectric power stations are proposed in the bill, to produce an average of 715,000 h.p. each. It is estimated that this would be equivalent to 5,000,000 tons of coal annually, or nearly one-eighth of the French coal output before the war. Fifteen years would be required for this work and the expenses are estimated at $500,000,000. The proposition as it now stands is to grant a concession for the whole undertaking to a company with a capital of $50,000,000 and the privilege of issuing bonds to ten times that amount. The bonds would be guaranteed by the State, which would appoint two-fifths of the membership of the administrative council, including the president.